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Comprehensive Environmental Response, Compensation, and Liability Act Technical Review

Y-12 Plant:
New Hope Pond Remedial Investigation Data Adequacy Summary

February 1993

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ACRONYMS AND INITIALISMS

ACL	alternate concentration limit
ARAR	applicable or relevant and appropriate requirement
BMAP	Biological Monitoring and Abatement Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRSDB	Chestnut Ridge Sediment Disposal Basin
DNAPL	dense, nonaqueous phase liquid
DOE	U.S. Department of Energy
DQO	data quality objective
EA	Environmental Assessment
EFPC	East Fork Poplar Creek
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility Study
GWQAP	Groundwater Quality Assessment Plan
GWQAR	Groundwater Quality Assessment Report
MCL	maximum contaminant level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NHP	New Hope Pond
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
TBC	to be considered
TDEC	Tennessee Department of Environment and Conservation
UEFPC	Upper East Fork Poplar Creek
UEFPCHR	Upper East Fork Poplar Creek Hydrogeologic Regime
VOC	volatile organic compound

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Y-12 Plant within the Oak Ridge Reservation (ORR) was in the process of meeting the requirements of the Resource Conservation and Recovery Act, as amended, when the U.S. Environmental Protection Agency (EPA) issued a final rule on November 21, 1989, placing the ORR on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List. Effective January 1, 1992, DOE, EPA, and the Tennessee Department of Environment and Conservation entered into a Federal Facility Agreement (FFA) to coordinate the compliance activities performed under CERCLA. As stipulated in Sect. IV of the FFA, remedies and corrective actions will comply with Sect. 121 of CERCLA, 42 United States Code Sect. 9621, to ". . . meet or exceed all applicable or relevant and appropriate federal and state laws and regulations."

Under CERCLA, a Remedial Investigation (RI)/Feasibility Study (FS) is conducted to characterize the nature and extent of risks posed by uncontrolled hazardous waste sites and to evaluate potential remedial action alternatives. The RI is the mechanism to collect data to characterize site conditions, determine the nature of the waste, and assess risk to human health and the environment. The FS is the mechanism for the development, screening, and detailed analysis of remedial action alternatives.

The Oak Ridge Y-12 Plant has been divided into three distinct hydrogeologic regimes based on topography, surface water drainage, and groundwater flow patterns. These regimes are the Bear Creek Hydrogeologic Regime (BCHR), the Upper East Fork Poplar Creek Hydrogeologic Regime (UEFPCHR), and the Chestnut Ridge Hydrogeologic Regime (DOE 1991). For the purpose of environmental restoration activities at Y-12, the Bear Creek Valley has been divided into two groundwater Operable Units, which are the BCHR and UEFPCHR (DOE 1992). The New Hope Pond (NHP) is within the UEFPCHR.

This report documents the evaluation of a large number of existing reports generated from environmental investigations pertaining to NHP performed over the last 10 to 15 years at the Y-12 Plant. Data generated from these reports were evaluated to determine whether sufficient information is available to support an RI for NHP. The results of the RI are typically presented as an analysis of site characteristics and the risk associated with conditions at the site (i.e., the results of a baseline and/or screening level risk assessment). Data should be analyzed with respect to their quality and adequacy to describe the site's physical characteristics, the contaminant source characteristics, the nature and extent of contamination, and contaminant fate and transport.

Data analysis should include a determination of the horizontal and vertical extent of contamination in surface water, groundwater, soil, stream sediments, and air. Cross-media contamination, such as the potential for contaminated soils to leach from the soil and act as a source for groundwater contamination, should also be considered (EPA 1988). The defensible validation of existing data is inherent to the successful evaluation of site characteristics.

Based on this evaluation, the following data gaps have been identified.

- Defensible validation is needed to establish the quality level of field and laboratory sampling, storage, chain-of-custody procedures, and analytical results for all data (groundwater, surface water, and soil/sediment samples).

- Further characterization is needed to determine the soil contaminates of concern and delineate the horizontal and vertical extent of soil contamination in the vicinity of NHP.

- Further characterization is needed to delineate the horizontal and vertical extent of groundwater contamination in the vicinity of NHP.

- Further characterization of the aquifer is needed to determine whether a dense, nonaqueous phase liquid plume exists below NHP and to define the groundwater flow system.

- A baseline risk assessment is needed using current EPA protocol and assuming the absence of institutional controls.

The identification of sources of contamination around NHP may be regarded as satisfactorily fulfilling the requirements for an RI if the data can be defensibly validated.

The data gaps identified in this report indicate that the CERCLA requirements for an RI have not been met. Resolution of the data gaps is necessary for continuing the CERCLA process.

If the results of a baseline and/or screening level risk assessment indicate a significant threat to public heath and/or the environment, an FS will be completed for the site. All potential sources in the immediate vicinity of NHP will be fully evaluated under CERCLA, and their potential effects will be considered during the selection of remedial action alternatives in an integrated RI/FS/Environmental Assessment.

1. INTRODUCTION

The enactment of the Resource Conservation and Recovery Act (RCRA) in 1976 and the subsequent Hazardous and Solid Waste Amendments of 1984 created requirements for managing hazardous wastes. The U.S. Department of Energy (DOE) Y-12 Plant within the Oak Ridge Reservation (ORR) was in the process of meeting the RCRA requirements when the U.S. Environmental Protection Agency (EPA) issued a final rule on November 21, 1989, placing the ORR on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List. Effective January 1, 1992, DOE, EPA, and the Tennessee Department of Environment and Conservation (TDEC) (formerly the Tennessee Department of Health and Environment) entered into a Federal Facility Agreement (FFA) for the purpose of coordinating the compliance activities performed under CERCLA. As stipulated in Sect. IV of the FFA, remedies and corrective actions will comply with Sect. 121 of CERCLA, 42 United States Code Sect. 9621, to ". . . meet or exceed all applicable or relevant and appropriate federal and state laws and regulations."

Under CERCLA, a Remedial Investigation (RI)/Feasibility Study (FS) is conducted to characterize the nature and extent of risks posed by uncontrolled hazardous waste sites and to evaluate potential remedial action alternatives. The RI serves as the mechanism for collecting data to characterize site conditions, determining the nature of the waste, and assessing risk to human health and the environment. The FS serves as the mechanism for the development, screening, and detailed analysis of remedial action alternatives. The primary objective of an FS is to develop an appropriate range of waste management options that will ensure the protection of human health and the environment. These options will focus on the complete elimination or destruction of hazardous substances at the site, the reduction of concentrations of hazardous substances to acceptable health-based levels, and/or the prevention of exposure to hazardous substances through engineering or institutional controls.

The National Environmental Policy Act (NEPA) established policies and goals for protecting the quality of the human environment. Specifically, Sect. 102(2) of NEPA mandated procedural requirements that federal agencies must consider when implementing decisions that may impact the environment. These requirements additionally dictate that environmental information be made available to the public during the decision-making process. Pursuant to the fulfillment of NEPA policy, DOE established Order 5440.1D to ensure that all DOE activities fully comply with NEPA. The preparation of an environmental assessment (EA) will be integrated with the CERCLA process in a combined RI/FS/EA report in accordance with DOE Order 5400.4.

This report documents the evaluation of a large number of existing reports generated from previous environmental investigations performed at the Y-12 Plant. Data generated from these reports were evaluated to determine whether sufficient information was available to generate an RI for the New Hope Pond (NHP). From this, a matrix table (Table A.1 in Appendix A) was prepared to summarize the adequacy of the documents reviewed.

The results of the RI are typically presented as an analysis of site characteristics and the risk associated with site conditions (i.e., the results of a baseline and/or screening level risk assessment). The evaluation of site characteristics should focus on determining the current extent of contamination and estimating the travel time to and predicting contaminant concentrations at potential exposure points. Data should be analyzed with respect to their quality and adequacy to describe and assess the site's physical characteristics, the contaminant source characteristics, the nature and extent of contamination, contaminant fate and transport, and ecological and human risks.

Data analysis should include a determination of the horizontal and vertical extent of contamination in surface water, groundwater, soil, stream sediments, and air. Cross-media contamination, such as the potential for contaminated soils to leach from the soil and act as a source for groundwater contamination, should also be considered (EPA 1988). Sufficient data should be provided so that general remedial objectives can be established. The defensible validation of existing data is vital to the successful evaluation of site characteristics and ultimate support for future CERCLA decision documents.

2. SITE BACKGROUND

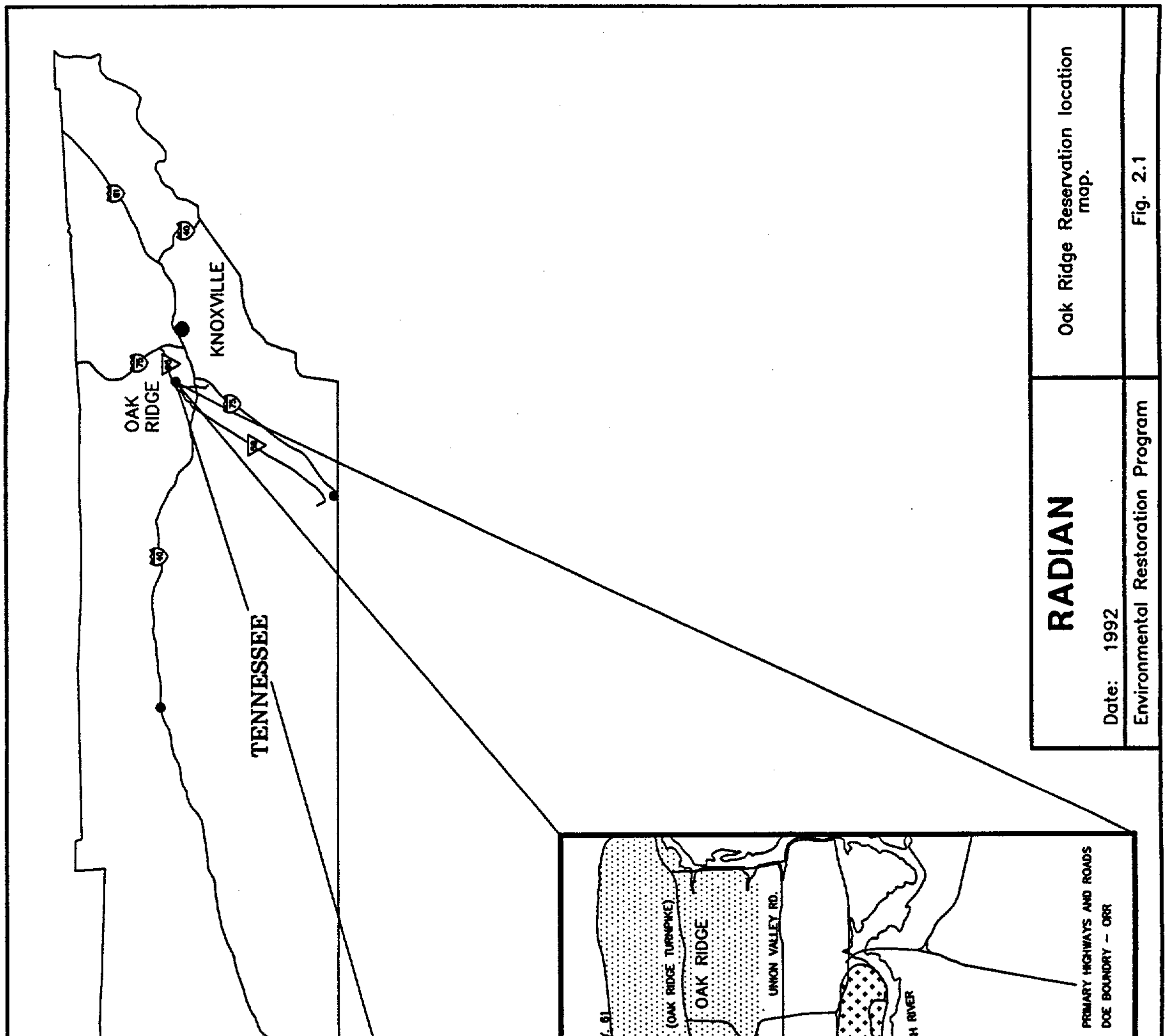
The DOE Y-12 Plant in Oak Ridge, Tennessee, was constructed as part of the Manhattan Project in the 1940s for the separation of fissile isotopes of uranium from natural uranium using the electromagnetic process. Until recently, the plant manufactured weapon components in support of DOE's weapons design laboratories. Areas in and around the plant are used for support activities and waste management.

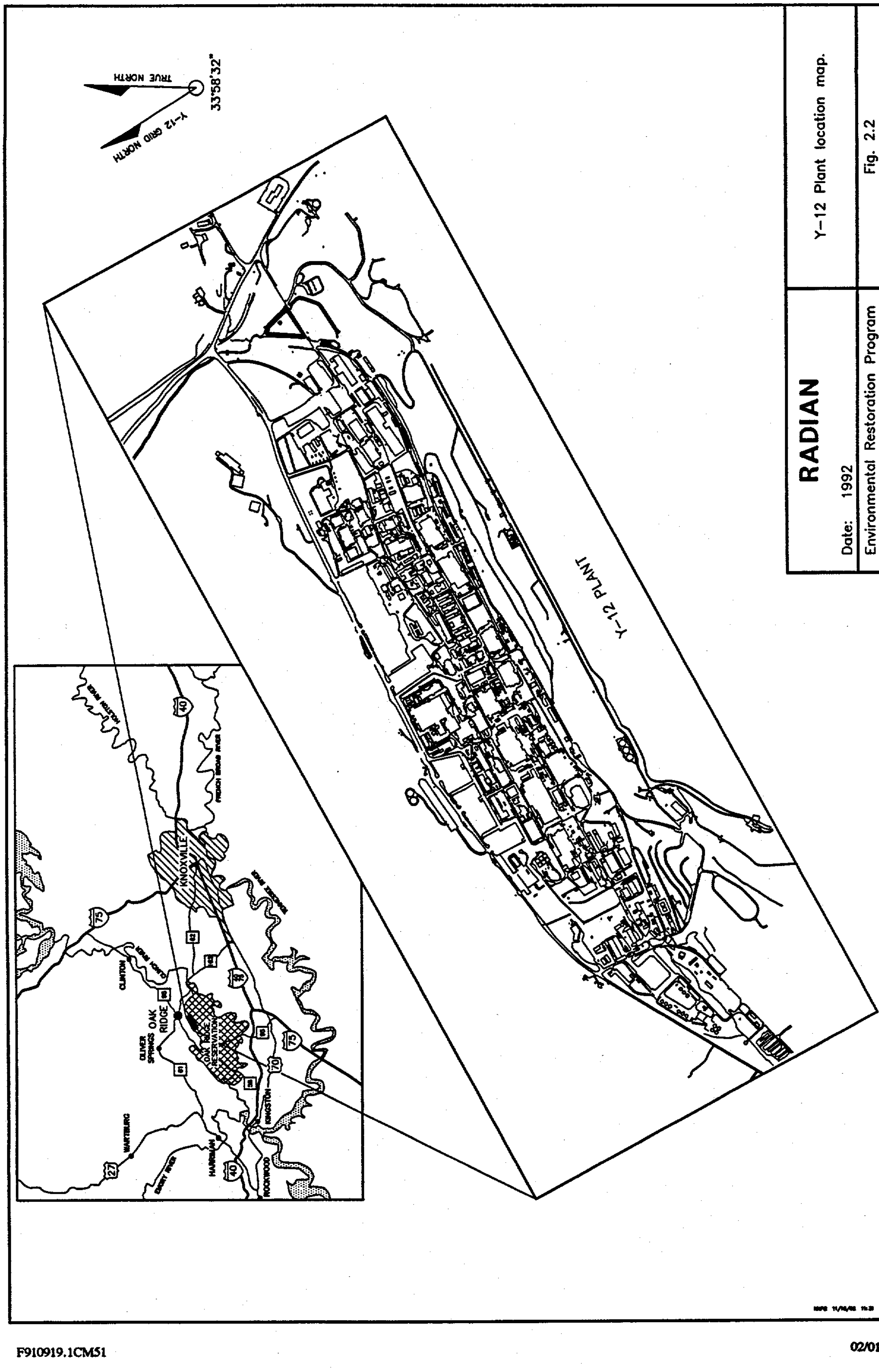
NHP is on the southeast side of Bear Creek Valley on the northern edge of Chestnut Ridge (Figs. 2.1, 2.2, and 2.3) just outside the east gates of the Y-12 Plant. It is in a controlled access area that is patrolled 24 h/d by security personnel.

NHP was constructed in 1962 as an unlined settling basin in the alluvium and residuum overlying the lower Maynardville Limestone and the upper Nolichucky Shale (Energy Systems 1988b). The pond was used to separate, via sedimentation, the mercury and other suspended contaminants from Y-12 Plant effluents prior to discharge into East Fork Poplar Creek (EFPC).

During the active life of the pond, the surface area was about 5.2 acres with a volume of approximately 9,390,000 gal (Energy Systems 1988b). The width ranged from 270 to 400 ft, and the length ranged from 450 to 950 ft with the long axis trending northeast (Kimbrough and McMahon 1988a).

While in operation, the NHP Hazardous Waste Disposal Unit received surface water run-off and flow from Upper East Fork Poplar Creek (UEFPC). The creek's flow mostly consisted of storm water drainage and outfalls from subsurface drains that collected industrial discharges such as once-through cooling water from the Y-12 Plant process areas. The UEFPC flow entered the pond through 12 discharge inlets from a diversion/distribution ditch that circumvented the south side of the pond (Energy Systems 1988a). Prior to discharge into the pond, influent from the creek passed through an oil-skimming basin that retained oils and allowed the water to enter the diversion/distribution ditch. Flow from the north end of NHP was directed through a skimmer weir at the basin outlet prior to discharge into EFPC (Geraghty & Miller 1989). In 1973, sediments from NHP were removed and placed in the Chestnut Ridge Sediment Disposal Basin (CRSDB). From 1973 to 1988, sediment from the inlet diversion ditch was removed periodically and disposed of in the CRSDB (Greer and Kimbrough 1988).


TENNESSEE
KNOXVILLE
OAK RIDGE
CITY OF OAK RIDGE
ST. HWY. 61
ST. HWY. 62
(OAK RIDGE TURNPIKE)
UNION VALLEY RD.
BETHEL VALLEY ROAD
BEAR CREEK ROAD
ANDERSON CO.
ROANE CO.
CLINCH RIVER
MELTON HILL DAM
K-25
PRIMARY HIGHWAYS AND ROADS
DOE BOUNDRY – ORR
MILES
RADIAN
Date: 1992
Environmental Restoration Program
Oak Ridge Reservation location map.
Fig. 2.1



RADIAN

Date: 1992

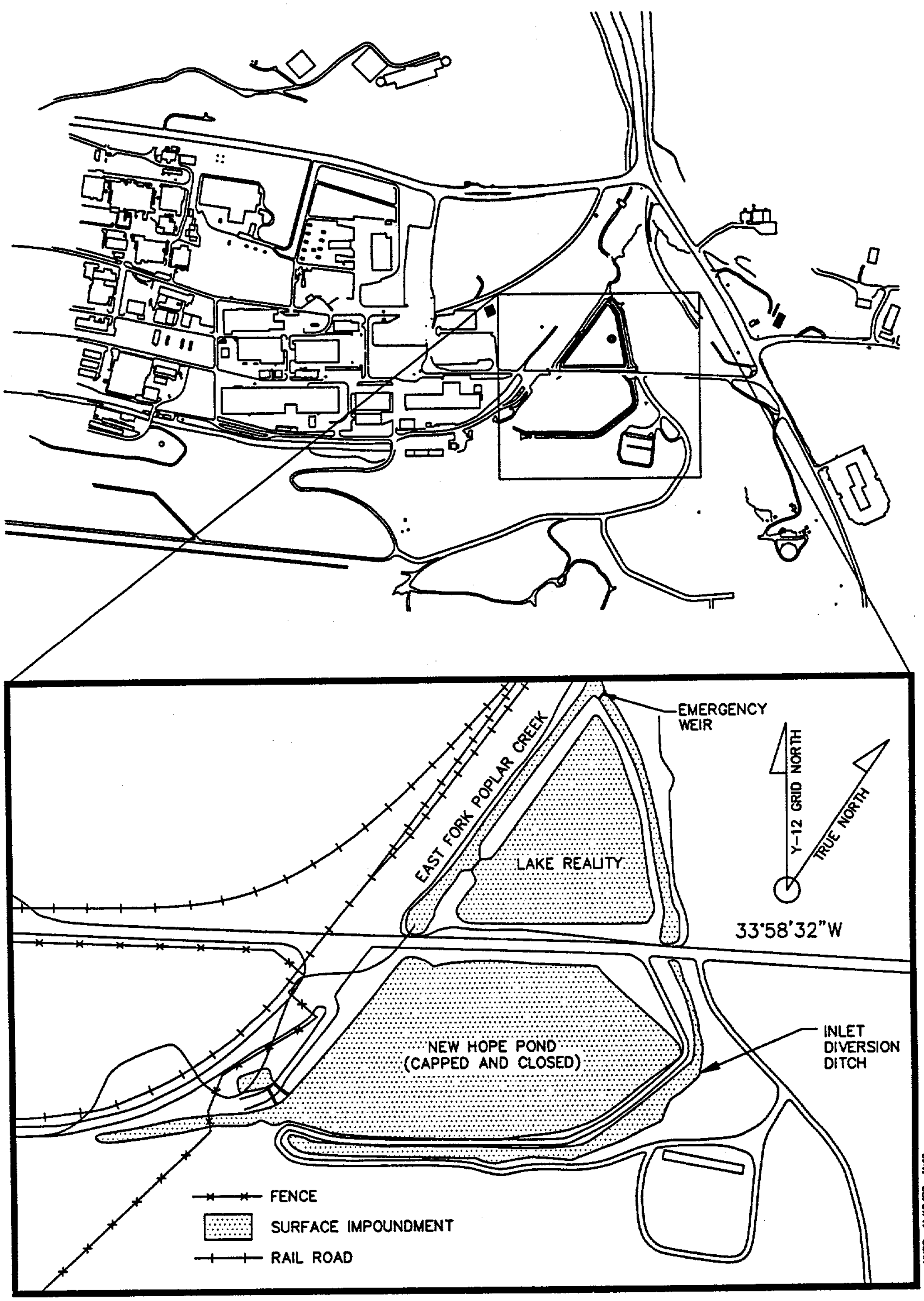
Environmental Restoration Program

Y-12 Plant location map.

Fig. 2.2

Y-12 PLANT

(EAST END)



RADIAN	New Hope Pond site location map.
Date: 1992	
Environmental Restoration Program	Fig. 2.3

In 1986, the Y-12 Plant initiated interim status groundwater monitoring at NHP. As part of the program, water table elevations in the vicinity of NHP were monitored using the 11 groundwater monitoring wells installed in 1985. Groundwater elevation measurements revealed complex flow patterns near NHP. An upward component of flow was observed in some wells, and changes in the groundwater elevation and flow direction occurred during periods of high precipitation (Energy Systems 1988a). A Groundwater Quality Assessment Plan (GWQAP) was prepared by Geraghty & Miller (1987) after evaluation of the 1986 and 1987 monitoring data. Monitoring under the GWQAP began in the first quarter of 1988. Six additional groundwater monitoring wells were also installed around NHP in 1988. Detection and assessment monitoring wells associated with NHP are shown on the figures in Appendix B. Groundwater Quality Assessment Reports (GWQARs) have been prepared from data gathered for each year since 1987 and have been submitted annually to TDEC.

NHP was taken out of operation in November 1988 when inflow from UEFPC was permanently diverted away from the pond and into Lake Reality, which was constructed adjacent to NHP (Fig. 2.3). NHP was drained between November 1988 and February 1989 immediately following the cessation of inflow from UEFPC. Following drainage, approximately 25,000 yd^3 of sediments were stabilized in place with coarse aggregate. A multilayered engineered cap was constructed over NHP. Approval of the certification of closure was granted on March 6, 1990 (Greer and Kimbrough 1988, Stone and Collins 1990).

NHP is one of several waste management facilities within the Upper East Fork Poplar Creek Hydrogeologic Regime (UEFPCHR). The GWQAR for 1990 data (HSW 1991b) concludes that NHP is inside the UEFPCHR contaminant plume and is probably not a major source of contamination in the area. This is evidenced by the fact that volatile organic compounds (VOCs), the major contaminants detected in monitoring wells in the area surrounding NHP, have been detected in similar concentrations in wells both upgradient and downgradient from the pond. The final status of NHP as a VOC source in UEFPCHR is still being evaluated (HSW 1991b).

2.1 REGULATORY HISTORY

The Y-12 Plant received a National Pollutant Discharge Elimination System (NPDES) permit (no. TN002968) in May 1985 . In accordance with conditions set forth in the permit, the discharge from NHP was monitored. The average discharge was calculated to be 7.8 million gal/d (Geraghty & Miller 1985).

Sampling and analysis efforts were conducted from 1982 to 1987 to determine the levels of contamination present in the sediments found in NHP. Although the analyses showed that the sediments did not exhibit the characteristic of Extraction Procedure Toxicity (Energy Systems 1988a), the concentrations of uranium, polychlorinated biphenyls (PCBs), and mercury, in addition to the potential presence of residuals from the plant effluent discharges prior to 1984, dictated that closure of NHP should be handled under RCRA (King et al. 1989). The presence of PCBs, mercury, and uranium made the removal of the NHP sediment a less viable closure option; therefore, the pond was closed as a landfill with the sediments left in place. A closure plan for NHP was submitted to TDEC in December 1987 (revised in February 1988) by Martin Marietta Energy Systems, Inc. At that time, the amount of sediment in NHP was estimated to be 25,000 yd^3.

In January 1986, RCRA interim status monitoring began, as required by TN Rule 1200-1-11-.05(6)(a)2. Quarterly sampling of groundwater in 1986 established background concentrations for drinking water parameters, water quality parameters, and contamination indicator parameters. Second quarter results from 1987 indicated that significant changes in pH and specific conductance had occurred in wells downgradient of NHP relative to background measurements. Low concentrations of VOCs were reported from 1986 and 1987 monitoring events.

NHP was covered with an engineered cap consisting of a clay layer, a flexible membrane liner, a geosynthetic drainage net overlain with a geotextile filter fabric, and finally a soil layer, which was fertilized, seeded, and mulched. The cap was completed in January 1990 and seeded in March 1990. TDEC approved the closure certification on March 6, 1990 (Stone and Collins 1990).

A RCRA post-closure permit application for NHP was prepared and submitted to the state of Tennessee in March 1988. The application contains a figure that shows the boundaries or point of compliance of the regulated unit. Maximum contaminant levels (MCLs) for the regulated contaminants are not to be exceeded outside the point of compliance, proposed to be the downgradient perimeter of the cap. RCRA requires groundwater monitoring to demonstrate compliance with the MCLs.

Documentation has shown that contaminant concentrations exceeding the regulatory limits have spread beyond the point of compliance for NHP. Under RCRA, the EPA Administrator has the authority to approve alternate concentration limits (ACLs) if the permit holder can demonstrate that these contaminant levels will not significantly endanger human health or the environment. The human and ecological risk assessments need to be addressed prior to acceptance of ACLs (McCoy 1992a). If the ACLs are exceeded, corrective action will be required to bring the site into compliance.

Results of the assessment monitoring program at NHP are summarized in the GWQARs submitted to the TDEC annually, as required under TN Rule 1200-1-11-.05(6)(e)2(ii). The GWQAR for 1988 focused solely on NHP; however, the 1989 and 1990 GWQARs were expanded to include the entire UEFPCHR (Geraghty & Miller, Inc. 1990a, 1990b; HSW 1991a and 1991b) because groundwater contamination was detected in wells hydrologically upgradient from NHP and numerous Y-12 Solid Waste Management Units are present upgradient of NHP (Geraghty & Miller, Inc. 1989). DOE has used each GWQAR as the forum for proposing changes and refinements to the assessment monitoring program at the site.

2.1.1 Groundwater Use

Most industrial and drinking water supplies in the Oak Ridge area are provided by surface water sources; however, rural areas not served by municipal water supply systems use residential wells as the common source. More than 100 wells and springs are used for domestic water supplies within an approximately 20-mile radius of the NHP. Most are south of the Clinch River; none are in Bear Creek Valley. The Oak Ridge municipal water supply system provides water for facilities in Bear Creek Valley. Within 20 miles of the NHP, there are 13 public groundwater supply systems and 7 industrial groundwater users (2 are within 12 miles of the site).

Oak Ridge National Laboratory (ORNL) began off-site drinking water sampling in 1989 at the direction of the DOE Oak Ridge Field Office. This sampling effort includes the water intake (Clinch River) for the Oak Ridge K-25 Plant (K-25) (formerly the Oak Ridge Gaseous Diffusion Plant), intake water (Watts Bar Lake) for the city of Kingston, and the spring water (Bacon Springs) for Oliver Springs. Selected off-site drinking water wells are routinely sampled in addition to the special one-time-only sampling requests from concerned citizens. At present there is no indication that groundwater contamination from ORR has left the reservation and infiltrated off-site drinking water wells. Drinking water has occasionally exceeded primary and secondary standards; however, this is typical of background fluctuations in groundwater quality and does not constitute a trend. Information pertaining to off-site drinking water can be obtained from the annual *Oak Ridge Reservation Environmental Report for 1990* (DOE 1991).

3. SITE CHARACTERIZATION

The following evaluation was performed to determine the adequacy of the available information to satisfy the elements of a CERCLA RI for NHP. Table A.1 of Appendix A summarizes the adequacy of the existing documentation to satisfy EPA requirements for an RI report.

3.1 DATA QUALITY LEVEL

The first step of the RI/FS process is the development of data quality objectives (DQOs) as defined by *Data Quality Objectives for Remedial Response Activities* (EPA 1987). This document states, "DQOs are qualitative and quantitative statements which specify the quality of the data required to support Agency decisions during remedial response activities."

Per the *Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual* (EPA 1991), "DQOs provide information on the limits of the data, which in turn dictate the proper uses of the data." Table 3.1 provides a summary of analytical levels appropriate for various data uses.

GWQARs using quality data for 1988, 1989, and 1990 (Geraghty & Miller, Inc. 1989, 1990a, and 1990b; HSW 1991a and 1991b) were derived from the quarterly analysis of groundwater samples collected from monitoring wells near the pond as part of RCRA compliance monitoring. All sampling and most analysis activities were conducted by personnel from the K-25 Site; selected radiochemical analyses were performed by the ORNL analytical laboratory. K-25 laboratory personnel were responsible for sample collection and transportation. As required by TN Rule 1200-1-11-.05(6)(c)5, the elevation of the groundwater surface in each monitoring well was determined prior to sample collection.

Analysis of groundwater for the assessment parameters was conducted in accordance with applicable procedures presented in *Test Methods for Evaluation of Solid Wastes* (EPA 1986). The method for establishing DQOs for selection of the analytical method used for each assessment parameter are specified in *Environmental Surveillance Procedures Quality Control Program* (Energy Systems 1988c). The QA procedures followed by K-25 for the analysis of VOCs are those associated with the EPA's Contract Laboratory Program for the analysis of the Target Compound List of parameters.

Table 3.1. Summary of analytical levels appropriate to data uses

Data uses	Analytical level	Type of analysis
Site characterization; monitoring during implementation	LEVEL I	• Total organic/inorganic vapor detection using portable instruments • Field test kits
Site characterization; evaluation of alternatives; engineering design; monitoring during implementation	LEVEL II	• Variety of organics by GC; inorganics by AA; XRF • Tentative ID; analyte-specific • Detection limits vary from low ppm to low ppb
Risk assessment PRP determination; site characterization; evaluation of alternatives; engineering design; monitoring during implementation	LEVEL III	• Organics/inorganics using EPA procedures other than CLP can be analyte-specific • RCRA-characteristic tests
Risk assessment PRP determination; evaluation of alternatives; engineering design; CERCLA actions of significant public concern	LEVEL IV	• HSL organics/inorganics by GC/MS; AA; ICP • Rigorous documentation • Rigorous QA/QC • Low ppb detection limit
Risk assessment PRP determination	LEVEL V	• Nonconventional parameters • Method-specific detection limits • Modification of existing methods • 40 CFR 261 Appendix VIII parameters

AA = atomic adsorption
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CLP = Contract Laboratory Program
GC = gas chromatography
EPA = Environmental Protection Agency
HSL = Hazardous Substance List
ICP = inductively coupled plasma
MS = mass spectroscopy
PRP = potentially responsible party
RCRA = Resource Conservation and Recovery Act
XRF = X-ray fluorescence

Before the data can be considered usable in the RI/FS process, defensible validation is needed for the quality level of laboratory sampling, storage, and chain-of-custody procedures as well as for analytical results for all data (e.g., groundwater, surface water, and soil/sediment samples).

3.2 SOURCES OF CONTAMINATION

Accurate records of the types and amounts of wastes deposited in NHP are not available. However, material spills and liquid wastes generated from Y-12 Plant operations and generally classified as toxic, corrosive, and radioactive are known to have been discharged into the pond through UEFPC. From 1950 to 1966, elemental mercury was used to separate lithium isotopes at the Y-12 Plant. Several significant mercury spills occurred during that time. Mercury from these spills entered subsurface drains that led to UEFPC, which in turn flowed into NHP. Influent and effluent water samples were collected for various studies to determine the efficiency of NHP to contain contaminant discharges (specifically mercury) from the plant. Although efficiency varied, the overall efficiency values for the pond were estimated at approximately 50% (Turner et al. 1985).

In addition, contaminated sediments within the Y-12 storm sewer system have been deposited in NHP. Mercury-contaminated sediments from tanks associated with Building 9201-4 may have been transported into NHP via the storm sewers. In fact, elemental mercury has been found in storm sewer catch basins downstream from these tanks (Van Ryn 1991). Closure of NHP in 1988 was performed with the pond sediments in place; therefore, the sediment contaminants listed in Sect 3.4.3 of the Closure Plan (Energy Systems 1988a) continue to remain in the NHP basin. Analytical results of sediment samples are presented in the NHP post-closure permit application (Greer and Kimbrough 1988) and the RCRA Appendix IX sampling and analysis report prepared by Roy F. Weston, Inc. (Kimbrough and McMahon 1988b).

In addition to NHP, several waste management units contribute to the contamination found in the UEFPCHR (HSW 1991a). The GWQARs for 1989 and 1990 data were expanded to include these additional units. Most of these units are operated or maintained by DOE or their subcontractors and are to the west and hydrologically upgradient of NHP. These potential sources are associated with areas on the reservation used for recycling and/or the treatment of hazardous materials, temporary storage of hazardous materials, and waste disposal.

3.3 NATURE AND EXTENT OF CONTAMINATION

The extent of contamination associated with the NHP was assessed by numerous individuals and summarized in several reports. A thorough summary of past works and a detailed assessment of the groundwater quality for NHP is presented in the *Post-Closure Permit Application for the New Hope Pond* (Greer and Kimbrough 1988), *RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond Analytical Data Summary* (Kimbrough and McMahon 1988b), and GWQARs prepared by Geraghty & Miller, Inc. (1989, 1990a, and 1990b) and HSW Environmental Consultants, Inc. (1991a and 1991b). The following sections summarize this information.

3.3.1 Surface Water Contamination

The RCRA cap covering NHP is intended to abate the spread of contamination by isolating the waste material and inhibiting the infiltration of precipitation and/or surface water into the contaminated sediments. Prior to the installation of the cap, influent and effluent surface water samples were collected from NHP to estimate the mercury retention efficiency of the pond. This was done to determine whether NHP was acting as a net source or a net sink for mercury emanating from the Y-12 Plant (Energy Systems 1988a). Effluent samples had lower mercury concentrations than influent samples, indicating that during its operation NHP retained approximately 50% of the mercury brought in through UEFPC. No contaminants were detected in surface water samples analyzed for RCRA Appendix IX parameters in the fall of 1987 (Kimbrough and McMahon 1988b). However, transport of contaminants from NHP may have contributed to contamination of the groundwater, soils, stream sediments, and surface waters of EFPC.

Based on the available information and if the data can be defensibly validated, it appears that the nature and extent of surface water contamination has been defined. There are no known hydraulic connections between contaminated groundwater and surface waters. If such connections are found to exist, further characterization of surface waters may be necessary.

3.3.2 Groundwater Contamination

Groundwater samples collected during the 1990 monitoring program at NHP were analyzed for the parameters listed in Table 3.2. This list (HSW 1991b) reflects efforts to focus the assessment of groundwater quality on the constituents present at concentrations above background levels or in excess of applicable water standards and water quality parameters necessary for the development of remedial alternatives.

Groundwater in the vicinity of NHP has been sampled quarterly as part of the GWQAP that began in 1988. Groundwater samples were collected as part of detection monitoring during

Table 3.2. 1991 groundwater monitoring parameters

VOCs	
Acetone	1,2-Dichloroethene (cis- and trans-)
Benzene	Cis-1,3-dichloropropane
Bromodichloromethane	Trans-1,3-dichloropropane
Bromoform	Ethylbenzene
Bromomethane	2-Hexanone
2-Butanone	4-Methyl-2-pentanone
Carbondisulfide	Methylene chloride
Carbon tetrachloride	1,1,2,2-Tetrachloroethane
Chloroethane	Tetrachloroethene
Chlorobenzene	Toluene
Chlorodibromethane	1,1,1-Trichloroethane
Chloroform	1,1,2-Trichloroethane
1,1-Dichloroethane	Trichloroethene
1,2-Dichloroethane	Vinyl chloride
1,1-Dichloroethene	Xylene
Metals	
Aluminum	Mercury
Antimony	Molybdenum
Arsenic	Nickel
Barium	Selenium
Beryllium	Silicon
Boron	Silver
Cadmium	Strontium
Chromium	Thorium
Cobalt	Titanium
Copper	Uranium
Iron	Vanadium
Lead	Zinc

Table 3.2 (continued)

Primary alpha emitters	Primary beta emitters
Americium-241 Neptunium-237 Plutonium-237 Plutonium-239 Radium-226 Thorium-228 Thorium-230 Thorium-232 Total radium Uranium-234 Uranium-235 Uranium-238	Cesium-134 Cesium-137 Cesium-144 Iodine-125 Iodine-126 Iodine-129 Iodine-131 Niobium-95 Protactinium Ruthenium Radium-228 Strontium-90 Technetium-99 Thorium-234 Tritium Zirconium
Radiochemical parameters	**Miscellaneous compounds**
Gross alpha activity Gross beta activity	Nitrate (as N) PCBs
Water quality parameters	
Miscellaneous parameters	**Major anions and cations**
pH Specific conductance Temperature Total dissolved solids Total organic carbon Total organic halogens Total suspended solids Turbidity Chemical oxygen demand Dissolved oxygen Phenols Reduction/oxidation potential Water level	Alkalinity Calcium Chloride Fluoride Magnesium Manganese Nitrate Potassium Sodium Sulfate

Source: Adapted from HSW 1991b.

1986 and 1987, prior to implementation of the GWQAP (Geraghty & Miller, Inc. 1987). The nature of groundwater contamination has been assessed from chemical analyses of groundwater collected from monitoring wells near NHP. The chemistry of the groundwater has been thoroughly addressed in previous reports (Geraghty & Miller, Inc. 1985, 1987, 1989, 1990a, and 1990b; HSW 1991a and 1991b).

Groundwater sampling from the 11 wells in the vicinity of NHP began on a quarterly basis in 1986. During August 1986, K-25 and EPA Region IV conducted extensive groundwater sampling at NHP. Collected samples were analyzed for radionuclides, total and dissolved metals, VOCs, semivolatile compounds, herbicides, pesticides, anions and cations, and water quality indicator parameters (Haase et.al. 1987). The report states that typically no organics in the semivolatile category were detected in the NHP groundwaters. Concentration values for herbicides and pesticides were well below the primary drinking water standards for these categories.

In December 1987, RCRA Appendix IX sampling was conducted by Roy F. Weston Inc. This sampling effort includes analysis for semivolatile organic compounds and herbicides/pesticides (Kimbrough and McMahon 1988a). The 1987 analytical results, again, indicated that semivolatiles and herbicides/pesticides were not a matter of concern and were deleted from the GWQAP. The analytical results of the 1986 and 1987 groundwater sampling confirmed the presence of other groundwater contamination. Subsequently, a GWQAP was prepared for groundwater monitoring to begin in the first quarter of 1988 (Geraghty & Miller, Inc. 1987).

The results of quarterly groundwater monitoring in 1988 were reported in the GWQAR for the UEFPCHR (Geraghty and Miller, Inc. 1989). Because the 1986 and 1987 sampling and analysis activities exceeded the groundwater sampling and analytical requirements set forth under TN Rule 1200-1-11-.05(6)(c)2 for detection monitoring, the list of parameters was modified to include only parameters that exceeded background levels and/or health criteria limits. VOCs detected in the 1988 samples include carbon tetrachloride, chloroform, tetrachloroethane, trichloroethane, trans-1,2-dichloroethene, and vinyl chloride. Lead, chromium, uranium, mercury, and gross alpha and gross beta activity were also detected in groundwater samples from the NHP monitoring wells.

The GWQARs for 1989 and 1990 concur with the results of the GWQAR for 1988, concluding that groundwater samples should continue to be analyzed for the parameters listed in Table 3.2. Both the 1989 and 1990 GWQARs (Geraghty & Miller, Inc. 1990a and 1990b; HSW 1991a and 1991b) conclude that the VOC contaminants are of greatest concern, with carbon tetrachloride averaging approximately 94% of the total VOCs in the shallow bedrock and 90% at intermediate depths.

The low solubilities and high densities of the VOCs in groundwater at NHP indicate that these compounds may exist as dense, nonaqueous phase liquids (DNAPLs) and are not simply dissolved constituents or adsorbates. DNAPLs can be expected to move downward through the saturated zone because of their relatively high densities (greater than water). Over time, they can persist as a column of DNAPL droplets entrained in pore-space water or fractures or as DNAPL pools below the original source of the contaminant (Walter et al. 1990).

The extent of groundwater contamination in UEFPCHR is described in the GWQARs (Geraghty & Miller, Inc. 1989, 1990a, and 1990b; HSW 1991a and 1991b). Water quality data from the monitoring well network were used to assess the approximate plume boundaries in the unconsolidated zone and the shallow and intermediate bedrock zones. Metal contamination and gross alpha and gross beta activity appear to be concentrated in the shallow bedrock and unconsolidated zones. VOC contamination has been documented from the unconsolidated zone to the intermediate bedrock; however, the full vertical extent of contamination has not been defined.

Appendix B plume maps show the extent of contamination in the unconsolidated zone and the shallow and intermediate bedrock zones. It appears that enough data exist to approximate the horizontal boundaries of groundwater contamination with the exception of VOCs (HSW 1991b), if the data can be defensibly validated. The vertical extent of VOC contamination has not been fully defined, nor has it been determined if NHP is a source of VOC contamination due to the fluctuating groundwater elevation and changing groundwater direction (McCoy 1992b). Further characterization of the aquifer is needed to determine whether the dissolved VOCs in the groundwater result from a DNAPL plume. Note that a DNAPL plume may also contain other high density constituents such as mercury.

3.3.3 Soil and Sediment Contamination

The extent of soil contamination at and adjacent to NHP has not been accurately delineated. Samples collected from the sediment in the basin were analyzed as discussed in previous sections. However, the nature and extent of soil contamination as a result of the pond's operation have not been validated.

Sediment samples collected from the pond by Union Carbide Corporation (1983) were found to contain concentrations of As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, cyanide, phenols, PCBs, methylene chloride, alkanes, bis (2-ethylhexyl) phthalate, and di-n-butylphthalate. A second sediment sampling was conducted by Roy F. Weston, Inc., in the fall of 1987; the sediments were analyzed for RCRA Appendix IX parameters (Kimbrough and McMahon 1988a). The same constituents detected in 1983 samples were also present in the 1987 samples. In addition, the 1987 samples showed acetone, chloroform, 2-butanone, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethane, tetrachloroethane, toluene, ethylbenzene, styrene, acrolein, acrylonitrile, and fluorotrichloromethane.

The lack of delineation of soil contamination in the vicinity of NHP is therefore identified as a data gap.

3.3.4 Air Contaminants

The release of contaminants into the atmosphere at the Y-12 Plant occurs almost exclusively as a result of plant production, maintenance and waste management operations, and steam operation. However, because of extensive use of air pollution control equipment at the Y-12 Plant, airborne discharges are within regulatory guidelines (DOE 1991). Based on 1990 data, ORR operations are having only a slight impact on local air quality and are not measurably impacting the regional air quality. Therefore, air contaminants are not considered a likely source of concern. The contaminants of concern via air pathway may need to be evaluated as site conditions change.

3.4 CONTAMINANT FATE AND TRANSPORT

The migration of the contaminants present in the groundwater system at NHP is predominantly controlled by the hydrologic setting of the pond and the physical and chemical properties of the contaminants. Numerous hydrogeologic and geochemistry surveys have been and continue to be conducted on the ORR and in Bear Creek Valley. It is a well documented fact that karst areas exist throughout the Maynardville Limestone. These fractures and potentially interconnected solution cavities may provide a pathway for groundwater flow and contaminant transport over varying distances (Bailey and Lee 1991). Documented drilling log records around the perimeter of NHP have indicated the presence of subterranean karst features (Greer and Kimbrough 1988). Plume evaluation and additional information concerning monitoring, sampling and analysis, and hydrogeologic framework are provided in GWQARs for the NHP (Geraghty & Miller, Inc. 1989, 1990a, and 1990b; HSW 1991a and 1991b).

3.5 BASELINE RISK ASSESSMENT

Baseline risk assessments are used to provide an evaluation of the potential threat to human health and the environment in the absence of any remedial actions. They provide the basis for determining whether remedial action is necessary and the justification for performing remedial actions. The baseline risk assessment process can be divided into four components: contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

The objective of contaminant identification is to screen available information on hazardous substances or wastes present at the site. The results of the screening are then used to identify contaminants of concern and focus subsequent efforts in the risk assessment process. The objectives of an exposure assessment are to identify actual or potential exposure pathways, to characterize potentially exposed populations, and to determine the extent of the exposure. Toxicity assessment considers the types of adverse health or environmental effects associated with chemical exposures, the relationships between the magnitude of exposure and adverse effects, and any related uncertainties such as the weight of evidence for a chemical's potential carcinogenicity in humans. In the final component of the risk assessment process, a characterization is developed for the potential risks of adverse health or environmental effects for each of the exposure scenarios derived in the exposure assessment. Risk estimates are obtained by integrating information developed during the exposure and toxicity assessments to characterize the potential or actual risk, including carcinogenic risks, noncarcinogenic risks, and environmental risks (EPA 1988).

No risk assessment has been conducted for NHP. A report was prepared regarding the biological monitoring of EFPC in response to the Biological Monitoring and Abatement Program (BMAP) required for the NPDES permit for Y-12. The objectives of the BMAP are to (1) demonstrate that effluent limitations established by the permit provide for the protection of EFPC (e.g., growth and propagation of fish and aquatic life) as designated by the state and (2) document the ecological effects of the water pollution control program (Loar et al. 1989). The tasks in the BMAP included ambient toxicity testing, bioaccumulation studies, biological indicator studies, and ecological surveys of stream communities. The BMAP report was prepared before the closure of NHP using data collected from the outfall of the pond into EFPC. The findings presented in the BMAP report (Loar et al. 1989) cannot be used as a baseline risk assessment; however, it is possible that some of the information gathered may be useful for inclusion in the baseline risk assessment.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires that baseline risk assessments provide an estimate of health risks for both current and future land use. In considering land usage, the NCP lists the following three categories as most often used to classify land during Superfund exposure assessments: (1) residential, (2) commercial/industrial, and (3) recreational. Currently, the NHP is considered commercial/industrial. In the past, for sites on ORR with limited access (e.g., the K-1407-B/C Ponds), baseline risk assessments typically focused on exposures by hypothetical individuals who could reside on-site at some point in the future (residential scenario). The most stringent cleanup levels will be expected for land where its purpose is not clearly stated. Furthermore, due to the long half-life of radionuclides known to have flowed into NHP and their probable retention in the sediments and their possible association with groundwater, a more conservative land use classification may be necessary (McCoy 1992b).

A baseline risk assessment that fully addresses all potential exposure pathways as well as all contaminants present at NHP must be developed to meet CERCLA requirements. The lack of a baseline risk assessment satisfying CERCLA guidelines is therefore identified as a data gap.

4. CONCLUSION

Data collected from previous environmental studies performed at the Y-12 Plant were evaluated to determine their adequacy to satisfy the EPA guidance requirements for an RI report. From this, a matrix table was prepared to summarize the adequacy of the documents reviewed (Table A.1 in Appendix A). The table's left-hand column, titled "Document number," lists the Information Resource Center document identification number for each document reviewed. A list of the reviewed documents is also included in Appendix A.

Based on this evaluation, the following data gaps have been identified.

- Defensible validation is needed to establish the quality level of field and laboratory sampling, storage, and chain-of-custody procedures and analytical results for all data (groundwater, surface water, and soil/sediment samples). Specifically, laboratory certification and assignment of the appropriate analytical level is required for data presented in the reports listed in Appendix C.

- Further characterization is needed to identify the nature and extent of soil contamination in the vicinity of NHP.

- Further characterization is needed to delineate the horizontal and vertical extent of groundwater contamination in the vicinity of NHP.

- Further characterization of the aquifer is needed to determine whether a DNAPL plume exists below NHP and to further define the groundwater flow system.

- A baseline risk assessment is needed using current EPA protocol and assuming the absence of institutional controls.

Based on this evaluation, the identification of sources of contamination in the vicinity of NHP may be regarded as fulfilling the DQOs.

The data gaps identified in this report indicate that the CERCLA requirements of an RI have not been met. Without defensible validation of the data quality level, the selection of a remedial action under the CERCLA process cannot be supported. Defensible validation of data to current CERCLA DQOs is needed to accurately define the nature and extent of contamination, which is subsequently used in the determination of contaminant fate and transport and the baseline risk assessment.

The delineation of the nature and extent of contamination in all media is necessary to perform a baseline risk assessment for all exposure routes. Results from the baseline and/or screening level risk assessment will be used to determine the overall scope of the FS and determine the appropriate type of remedial response under CERCLA.

Currently available data are inadequate for a conceptual understanding of the contamination in all media in the area surrounding NHP. The conceptual site model, which is typically included in the RI, uses information about known and suspected sources of contamination, types of contaminants and affected media, known and potential routes of migration, and known or potential human and environmental receptors to evaluate potential risks to human health and the environment. This model then assists in identifying potential remedial technologies. Resolving the data gaps will aid in the refinement of a conceptual site model.

Following the conceptual understanding of NHP, a list of preliminary remedial action objectives should be developed. This evaluation will result in a preliminary classification of remedial actions based on the initially identified potential routes of exposure and associated receptors. Following the completion of site characterization and the RI, the FS will serve as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

Based on currently available information, a preliminary identification of applicable or relevant and appropriate requirements (ARARs) can be made that can assist in identifying remedial alternatives. Remedial action at NHP will be undertaken in accordance with all ARARs as issued under federal, state, or local environmental laws, unless waived under special circumstances by EPA. Appendix D includes a preliminary identification of potential ARARs and to be considered (TBC) guidance for NHP. As the RI/FS progresses, each ARAR will be further defined.

Resolution of the data gaps is necessary for fulfilling the requirements of an RI. If the results of a baseline and/or screening level risk assessment indicate a significant threat to public health and/or the environment, the CERCLA process requires that an FS be completed for the site. All potential sources in the immediate area of NHP will be fully evaluated under CERCLA, and their potential effects will be considered in the selection of remedial action alternatives in an integrated RI/FS/EA.

5. BIBLIOGRAPHY

Bailey, Z.C. and Lee, R.W. 1991. Hydrogeology and Geochemistry in Bear Creek and Union Valleys, Near Oak Ridge, Tennessee, Water Resource Investigations Report 90-4008, IRC# 910930.0152.

DOE (U.S. Department of Energy) 1991. Oak Ridge Reservation Environmental Report for 1990, ES/ESH-18/V1, IRC# 911014.0035.

DOE 1992. Oak Ridge Reservation Site Management Plan for the Environmental Restoration Program, DOE/OR-1001/R2, IRC# 921201.0060.

Energy Systems 1988a. *Revised Closure Plan for New Hope Pond*, Y/TS-389, IRC# 900831.0011.

Energy Systems 1988b. *Final Environmental Assessment, Y-12 RCRA Closure Initiation Projects*, DOE/EA-0362, IRC# 900521.0337.

Energy Systems 1988c. *Environmental Surveillance Procedures Quality Control Program*, ESH/SUB/87-21706/1, IRC# 910701.0010.

EPA (U.S. Environmental Protection Agency) 1986. *Test Methods for Evaluation of Solid Waste*, Third Edition, EPA/SW 846, IRC# 920115.0049.

EPA 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/004, IRC# 900723.0026.

EPA 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540G-89004, IRC# 900521.0224.

EPA 1989. *RCRA Facility Investigations (RFI) Guidance*, Vol. I, EPA/530/SW-89-031, IRC# 901227.0001.

EPA 1991. *Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual*, IRC# 920115.0063.

Geraghty & Miller, Inc. 1985. *Proposed Groundwater Monitoring Plans for the New Hope Pond and for Four Disposal Sites on Chestnut Ridge*, Y/SUB/85-00206C/2, IRC# 910531.0009.

Geraghty & Miller, Inc. 1987. *Proposed RCRA Ground-Water Quality Assessment Plan for New Hope Pond at the Y-12 Plant*, Y/SUB/87-00206C/17, IRC# 900809.0016.

Geraghty & Miller, Inc. 1989. *Groundwater Quality Assessment for the New Hope Pond Hazardous Waste Disposal Unit at the Y-12 Plant, 1988*, Y/SUB/89-00206C/5, IRC# 900813.0017.

Geraghty & Miller, Inc. 1990a. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Groundwater Quality Data and Calculated Rate of Contaminant Migration*, Y/SUB/90-00206C/2 Part 1, IRC# 910601.0077.

Geraghty & Miller, Inc. 1990b. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant, 1989: Data Interpretation and Proposed Modifications for 1990*, Y/SUB/90-00206C/2 Part 2, IRC# 910531.0008.

Greer, J.K. and C.W. Kimbrough 1988. *Post-Closure Permit Application for the New Hope Pond*, Y/SUB/88-86020C/1, IRC# 900521.0113.

Haase, C.S. et al. 1987. *Preliminary Analysis of Groundwater Data for the New Hope Pond Site at the Y-12 Plant, Oak Ridge, Tennessee*, Y/TS-280, IRC# 900521.0076.

HSW Environmental Consultants, Inc. 1991a. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Groundwater Quality Data and Calculated Rate of Contaminant Migration*, Y/SUB/91-YP507C/2 Part 1, IRC# 920801.0017.

HSW Environmental Consultants, Inc. 1991b. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Data Interpretations and Proposed Program Modifications*, Y/SUB/91-YP507C/2 Part 2, IRC# 920215.0015.

Kimbrough, C.W. and L.W. McMahon 1988a. *RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond and Chestnut Ridge Sediment Disposal Basin Field Sampling Plan and Field Data*, Y/SUB/88-97376/1, IRC# 900521.0200.

Kimbrough, C.W. and L.W. McMahon 1988b. *RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond Analytical Data Summary*, Y/SUB/88-97376/2, IRC# 900810.0001.

King, H.L. et al. 1989. *Groundwater Investigation Drilling Program, Fiscal Years 1986, 1987, and 1988, Y-12 Plant, Oak Ridge, Tennessee*, Y/SUB/89-E4371V/2, IRC# 900521.0132.

Loar, J.M. et al. 1989. *The Oak Ridge Y-12 Plant Biological Monitoring and Abatement Program for East Fork Poplar Creek*, ORNL/TM-10265, IRC# 900713.0013.

McCoy, D.R., 1992a. Adequacy Summary Comments on New Hope Pond Y-12 Plant, Letter Transmitted to Nelson Lingle, FFA Manager, Environmental Restoration Division, DOE, Oak Ridge Operations.

McCoy, D.R., 1992b. Adequacy Summary Comments on S-3 Ponds Bear Creek Y-12 Plant, Letter Transmitted to Nelson Lingle, FFA Manager, Environmental Restoration Division, DOE, Oak Ridge Operations.

Stone, J.E. and E.T. Collins 1990. *New Hope Pond (T-010) Summary of Closure Under Rules Governing Hazardous Waste Management in Tennessee,* Y/TS-389/2, IRC# 900809.0015.

Turner, R.R. et al. 1985. *Sources and Discharges of Mercury in Drainage Waters at the Oak Ridge Y-12 Plant,* Y/TS-90, IRC# 910909.0032.

Union Carbide Corporation 1983. *Characterization of Sediments from New Hope Pond and the New Hope Pond Sediment Basin,* Y/IA-164, IRC# 900807.0013.

Van Ryn, F.R. 1991. *Interim Action Proposed Plan: Mercury Tank Remediation at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee,* ES/ER-21&D2, IRC# 910704.0095.

Walter, K.A. et al. 1990. *Analysis of Proposed Postclosure Alternatives for the Bear Creek Burial Grounds at the Oak Ridge Y-12 Plant, Oak Ridge, TN,* Y/ER-10, IRC# 901203.0030.

Appendix A

Y-12 PLANT NEW HOPE POND

DOCUMENT EVALUATION

Table A.1. Document evaluation

Document number	1.2 Site background			2.0 Study area characterization investigation								
	1.2.1 Site description	1.2.2 Site history	1.2.3 Previous investigations	2.1.1 Surface features	2.1.2 Contaminant source	2.1.3 Meteor-ology	2.1.4 Surface water and sediment	2.1.5 Geo-logical	2.1.6 Soil and vadose zone	2.1.7 Ground-water	2.1.8 Human population	2.1.9 Eco-logical
900521.0076												
900521.0091							I					
900521.0095					I		I					I
900521.0113	I	I	I									
900521.0132												
900521.0200	I						I					
900521.0208		I					I		I	I		I
910909.0032		I			I		I					
900620.0006												
900807.0013							I					
900809.0015	I	I										
900809.0016	I	I								I		

KEY: I = Provides information necessary for the completion of an RI.

Table A.1 (continued)

Document number	1.2 Site background			2.0 Study Area Characterization Investigation								
	1.2.1 Site description	1.2.2 Site history	1.2.3 Previous investigations	2.1.1 Surface features	2.1.2 Contaminant source	2.1.3 Meteor-ology	2.1.4 Surface water and sediment	2.1.5 Geo-logical	2.1.6 Soil and vadose zone	2.1.7 Ground-water	2.1.8 Human population	2.1.9 Eco-logical
900810.0001												
900813.0012												
900813.0017	I	I		I	I					I		
900831.0011	I	I										
910531.0008												
910531.0009										I		
910601.0077	I	I	I	I	I					I		
920215.0015	I	I		I	I							
910930.0152			I						I			
900521.0174			I		I					I		
ADEQUATE? [Yes/No/Not Applicable (NA)]	Y	Y	Y	Y	Y	NA	Y	NA	Y	Y	NA	Y

KEY: I = Provides information necessary for the completion of an RI.

Table A.1 (continued)

Document number	3.0 Physical characteristics of the study area								4.0 Nature and extent of contamination				
	3.1.1 Surface features	3.1.2 Meteor-ology	3.1.3 Surface water hydrology	3.1.4 Geology	3.1.5 Soils	3.1.6 Hydro-geology	3.1.7 Demo-graphics	3.1.8 Ecology	4.1.1 Sources	4.1.2 Soils and vadose zone	4.1.3 Ground-water	4.1.4 Surface water and sediments	4.1.5 Air
900521.0076						I							
900521.0091			I	I									
900521.0095			I					I				I	
900521.0113			I	I		I			I				
900521.0132													
900521.0200													
900521.0208			I	I	I	I			I			I	I
910909.0032			I										
900620.0006		I	I				I	I			I		
900807.0013					I					I			
900809.0015													
900809.0016				I		I					I		

KEY: I = Provides information necessary for the completion of an RI.

Table A.1 (continued)

Document number	3.0 Physical characteristics of the study area								4.0 Nature and extent of contamination				
	3.1.1 Surface features	3.1.2 Meteor-ology	3.1.3 Surface water hydrology	3.1.4 Geology	3.1.5 Soils	3.1.6 Hydro-geology	3.1.7 Demo-graphics	3.1.8 Ecology	4.1.1 Sources	4.1.2 Soils and vadose zone	4.1.3 Ground-water	4.1.4 Surface water and sediments	4.1.5 Air
900810.0001						I							
900813.0012						I							
900813.0017	I		I	I		I							
900831.0011													
910531.0008						I					I		
910531.0009													
910601.0077	I		I	I		I			I		I	I	
920215.0015	I		I	I		I			I		I		
910930.0152		I	I	I	I	I							
900521.0174			I	I						I	I	I	
ADEQUATE? [Yes/No/Not Applicable (NA)]	Y	Y	Y	Y	N	N	Y	N	N	N	N	Y	Y

KEY: I = Provides information necessary for the completion of an RI.

Table A.1 (continued)

Document number	5.0 Contaminant fate and transport				6.0 Baseline risk assessment			
			5.3 Contaminant migration		6.1 Human health evaluation			
	5.1 Potential routes of migration	5.2 Persistence in the environment	5.3.1 Factors affecting migration	5.3.2 Modeling method	6.1.1 Exposure assessment	6.1.2 Toxicity assessment	6.1.3 Risk characterization	6.2 Environmental evaluation
900521.0076								
900521.0091								
900521.0095	I	I	I		I			I
900521.0113								
900521.0132	I				I			
900521.0200								
900521.0208								
910909.0032								
900620.0006								
900807.0013								
900809.0015								
900809.0016								

KEY: I = Provides information necessary for the completion of an RI.

Table A.1 (continued)

Document number	5.0 Contaminant fate and transport				6.0 Baseline risk assessment			
	5.1 Potential routes of migration	5.2 Persistence in the environment	5.3 Contaminant migration		6.1 Human health evaluation			6.2 Environmental evaluation
			5.3.1 Factors affecting migration	5.3.2 Modeling method	6.1.1 Exposure assessment	6.1.2 Toxicity assessment	6.1.3 Risk characterization	
900810.0001								
900813.0012								
900813.0017	I		I					
900831.0011								
910531.0008								
910531.0009								
910601.0077	I		I					
920215.0015	I		I					
910930.0152								
900521.0174								
ADEQUATE? Yes/No/Not Applicable (NA)]	N	N	N	N	N	N	N	N

KEY: I = Provides information necessary for the completion of an RI.

LIST OF DOCUMENTS REVIEWED

IRC No.: 900521.0076
Document: Y/TS-280
Title: *Preliminary Analysis of Groundwater Data for the New Hope Pond Site at the Y-12 Plant, Oak Ridge, Tennessee*
Author: Haase, C. S.; King, H. L.; Gillis, G. A.; Kimbrough, C. W.; Mercier, T. M.
Corp: Martin Marietta Energy Systems, Inc.
Date: September 1987

IRC No.: 900521.0091
Title: *Sediment Transport Task 3 - Instream Contaminant Study*
Corp: Tennessee Valley Authority, Office of Natural Resources and Economic Development
Date: August 1985

IRC No.: 900521.0095
Document: ORNL/TM-8894
Title: *Mercury Contamination in East Fork Poplar Creek and Bear Creek*
Author: Van Winkle, W.; Counts, R. W.; Dorsey, J. G.; Elwood, J. W.; Lowe, V. W., Jr.; McElhaney, R.; Schlotzhauer, S. D.; Taylor, F. G., Jr.; Turner, R. R.
Corp: Martin Marietta Energy Systems, Inc.
Date: February 1984

IRC No.: 900521.0113
Document: Y/SUB/88-86020C/1
Title: *Post-Closure Permit Application for the New Hope Pond*
Author: Greer, J. K.; Kimbrough, C. W.
Corp: Battelle
Date: March 1988

IRC No.: 900521.0132
Document: Y/SUB/89-E4371V/2
Title: *Groundwater Investigation Drilling Program, Fiscal Years 1986, 1987, and 1988, Y-12 Plant, Oak Ridge, Tennessee*
Author: King, H. L.; Haase, C. S.; LaRue, D. L.
Corp: C-E Environmental, Inc./E. C. Jordan Company
Date: July 1989

IRC No.: 900521.0200
Document: Y/SUB/88-97376/1
Title: *RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond and Chestnut Ridge Sediment Disposal Basin Field Sampling Plan and Field Data*
Author: Kimbrough, C. W.; McMahon, L. W.
Corp: Roy F. Weston, Inc.
Date: October 1988

IRC No.: 900521.0208
Document: Y/TS-366 R1
Title: *RCRA Facility Investigation Plan for East Fork Poplar Creek and the Oak Ridge Sewer Line Beltway, Oak Ridge Y-12 Plant, Oak Ridge Tennessee*
Author: Welch, S. H.
Corp: Martin Marietta Energy Systems, Inc.
Date: May 1989

IRC No.: 900521.0174
Document: Water Resources Investigation Report No. 88-4219
Title: *An Investigation of Shallow Ground-Water Quality Near East Fork Poplar Creek, Oak Ridge, Tennessee*
Author: Carmichael, John K.
Corp: U.S. Geological Survey
Date: 1989

IRC No.: 900521.0337
Document: DOE/EA-0362
Title: *Revised Final Environmental Assessment, Y-12 RCRA Closure Initiation Projects*
Corp: Martin Marietta Energy Systems, Inc.
Date: June 1988

IRC No.: 900807.0013
Document: Y/IA-164
Title: *Characterization of Sediments from New Hope Pond and the New Hope Pond Sediment Basin*
Corp: Union Carbide Corporation
Date: December 1983

IRC No.: 900809.0015
Document: Y/TS-389/2
Title: *New Hope Pond (T-010) Summary of Closure Under Rules Governing Hazardous Waste Management in Tennessee*
Author: Stone, J. E.; Collins, E. T.
Corp: Martin Marietta Energy Systems, Inc.
Date: March 1990

IRC No.: 900809.0016
Document: Y/SUB/87-00206C/17
Title: *Proposed RCRA Ground-Water Quality Assessment Plan for New Hope Pond at the Y-12 Plant*
Corp: Geraghty & Miller, Inc.
Date: December 1987

IRC No.:	900810.0001
Document:	Y/SUB/88-97376/2
Title:	*RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond Analytical Data Summary*
Author:	Kimbrough, C. W.; McMahon, L. W.
Corp:	Roy F. Weston, Inc.
Date:	October 1988

IRC No.:	900813.0012
Document:	Y/TS-272; ESD-2923
Title:	*Preliminary Hydrological and Hydrochemical Assessment of the Chestnut Ridge Security Pits, the Chestnut Ridge Sludge Disposal Basin, and the New Hope Pond Sites at the Y-12 Plant, Oak Ridge, Tennessee*
Author:	Haase, C. S.; King, H. L.; Gillis, G. A.
Corp:	Martin Marietta Energy Systems, Inc.
Date:	July 1987

IRC No.:	900813.0017
Document:	Y/SUB/89-00206C/5
Title:	*Groundwater Quality Assessment for the New Hope Pond Hazardous Waste Disposal Unit at the Y-12 Plant, 1988*
Corp:	Geraghty & Miller, Inc.
Date:	February 1989

IRC No.:	900831.0011
Document:	Y/TS-389
Title:	*Revised Closure Plan for New Hope Pond*
Corp:	Martin Marietta Energy Systems, Inc.
Date:	February 1988

IRC No.:	910531.0008
Document:	Y/SUB/90-00206C/2 Part 2
Title:	*Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Data Interpretation and Proposed Modifications for 1990*
Corp:	Geraghty & Miller, Inc.
Date:	May 1990

IRC No.:	910531.0009
Document:	Y/SUB/85-00206C/2
Title:	*Proposed Groundwater Monitoring Plans for the New Hope Pond and for Four Disposal Sites on Chestnut Ridge*
Corp:	Geraghty & Miller, Inc.
Date:	July 1985

IRC No.: 910601.0077
Document: Y/SUB/90-00206C/2 Part 1
Title: *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Groundwater Quality Data and Calculated Rate of Contaminant Migration*
Corp: HSW Environmental Consultants, Inc.
Date: February 1990

IRC No.: 910909.0032
Document: Y/TS-90
Title: *Sources and Discharges of Mercury in Drainage Waters at the Oak Ridge Y-12 Plant*
Author: Turner, R. R.; Kamp, G. E.; Bogle, M. A.; Switek, J.; McElhaney, R.
Corp: Martin Marietta Energy Systems, Inc.
Date: June 1985

IRC No.: 910930.0152
Document: Water Resources Investigation Report No. 90-4008
Title: *Hydrogeology and Geochemistry in Bear Creek and Union Valleys, Near Oak Ridge, Tennessee*
Author: Bailey, Zelda Chapman; Lee, Roger W.
Corp: U.S. Geological Survey
Date: 1991

IRC No.: 920215.0015
Document: Y/SUB/91-YP507C/2 Part 2
Title: *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Data Interpretations and Proposed Modifications*
Corp: HSW Environmental Consultants, Inc.
Date: June 1991

Appendix B

CONTAMINANT PLUME MAPS

Appendix C

DOCUMENTS FOR WHICH DATA VALIDATION AND ASSIGNMENT OF APPROPRIATE ANALYTICAL LEVEL IS REQUESTED

Appendix C

DOCUMENTS FOR WHICH DATA VALIDATION AND ASSIGNMENT OF APPROPRIATE ANALYTICAL LEVEL IS REQUESTED

HSW Environmental Consultants, Inc. 1991a. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Groundwater Quality Data and Calculated Rate of Contaminant Migration*, Y/SUB/91-YP507C/2 Part 1, IRC #920801.0017.

HSW Environmental Consultants, Inc. 1991b. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Data Interpretations and Proposed Program Modifications*, Y/SUB/91-YP507C/2 Part 2, IRC #920215.0015.

Geraghty & Miller, Inc. 1990a. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrologic Regime at the Y-12 Plant: Groundwater Quality Data and Calculated Rate of Contamination Migration*, Y/SUB/90-00206C/2/Part 1, IRC #910601.0077.

Geraghty & Miller, Inc. 1990b. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: Data Interpretation and Proposed Modifications for 1990*, Y/SUB/90-00206C/2/Part 2, IRC #910531.0008.

Geraghty & Miller, Inc. February 1989. *Groundwater Quality Assessment for the New Hope Pond Hazardous Waste Disposal Unit at the Y-12 Plant, 1988*, Y/SUB/89-00206C/5, IRC #900813.0017.

Kimbrough, C. W. and L. W. McMahon 1988b. *RCRA Appendix IX Sampling and Analysis Project at the Oak Ridge Y-12 Plant: New Hope Pond Analytical Data Summary*, Y/SUB/88-97376/2, IRC #900810.0001.

Appendix D

PRELIMINARY ARARs AND TBCs

Table D.1. Preliminary identification of potential ARARs and TBCs[a] for the New Hope Pond HWDU

Law or regulation	Federal reference	Chemical-specific	Action-specific	Location-specific	State reference
NCP	40 CFR 300	NA	Establishes basis for site remediation	NA	NA
SDWA a) primary drinking water standards b) secondary drinking water standards	 40 CFR 141 40 CFR 143	Applicable to drinking water supplies using MCLs	Applicable to groundwater MCLs and water that may be consumed after any treatment alternative	NA	Public Water Systems Chapter 1200-5-1 Revised Nov. 10, 1988 of the Rules of the TDEC 1200-5-1-.12
Worker safety and health protection	OSHA 29 CFR 1910.120	NA	Applicable to worker safety during remedial activities	NA	NA
NEPA	NEPA Sect. 102 (2)(c) DOE Order 5400.4 DOE Order 5440.1D 40 CFR Parts 1500-1508	NA	Applicable to federal actions with the potential to significantly impact the quality of the environment	NA	NA
CWA	CWA Part 304; Executive Order 11990 Protection of Wetlands; 40 CFR 6, Appendix A; 40 CFR 230.10; 33 CFR 320-330	Applicable ambient water quality criteria	NA	Minimize adverse effects on wetlands	Rules of the TDEC Tennessee Water Quality Criteria, Chapter 1200-4-3, General Water Quality Criteria for the Definition and Control of Pollution in the Waters of Tennessee
Environmental protection standards for the management, storage, and disposal of spent nuclear fuel, high level wastes, and transuranics	40 CFR 191; 40 CFR 191.03; 40 CFR 191.15; 40 CFR 191.04; DOE Order 5400.5	Dose exposure limits and the consideration of all possible pathways	NA	NA	NA
RCRA	40 CFR 264 Subpart F; 40 CFR 264.310; 40 CFR 270; 40 CFR 265; 40 CFR 268; Executive Order 11988 Floodplain Management; 40 CFR 6 Appendix A	Applicable in groundwater using MCLs; land disposal restrictions	Applicable to hazardous waste management to comply with the state's RCRA program for permitted and/or interim status facilities	Minimize the adverse effects and restore the values of a floodplain; help reduce environmental stress in flood prone areas	Tennessee Hazardous Waste Management Rule Chapter 1200-1-11-.06, -.05, -.07, -.10

Table D.1 (continued)

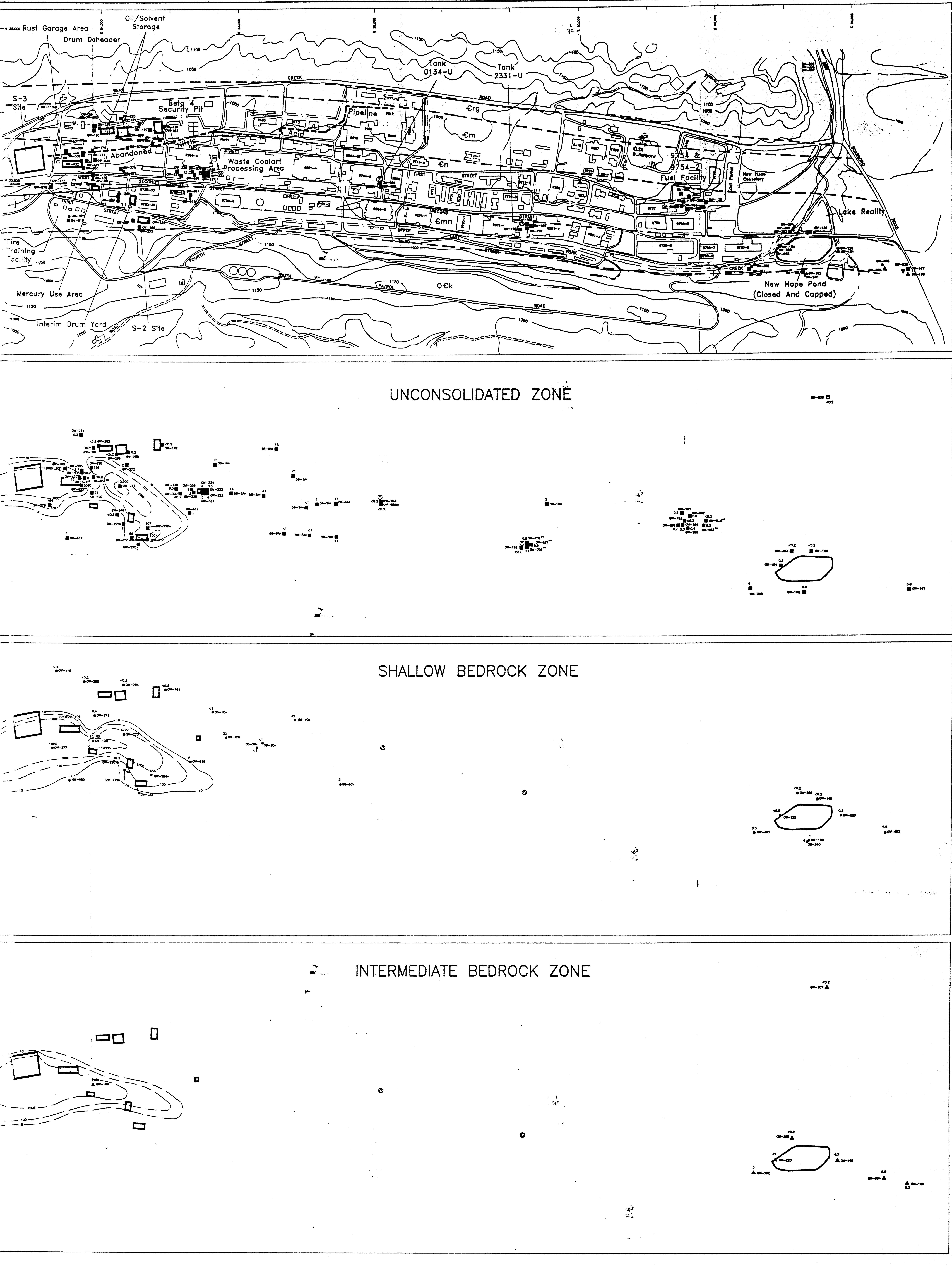
Law or regulation	Federal reference	Chemical-specific	Action-specific	Location-specific	State reference
AEA	AEA 1959, as amended	NA	Applicable in regulatory authority and programs for radioactive wastes	NA	NA
Underground injection regulations	40 CFR 146.3	Exemptions for designation of groundwater as domestic water supply	NA	NA	Underground Injection Control Program, Rules of the Water Control Board, Chapter 1200-4-6 (p. 282)
Fish and wildlife protection	Fish and Wildlife Coordination Act 16 USC 661 et seq.	NA	NA	Stream and river protection	Tennessee Scenic Rivers Act of 1968 TCA Sect. 11-1401
Primary National Ambient Air Quality Standards	40 CFR 50	Applicable ambient air quality criteria	NA	NA	TDEC Division of Air Pollution Control, Rule Chapter 1200-3-3
TSCA	40 CFR 761.60-761.75	Storage and disposal requirements for PCB-contaminated materials	NA	NA	NA
NESHAP	54 FR 51654, Dec. 15, 1989	Airborne emissions of radionuclides	NA	NA	NA

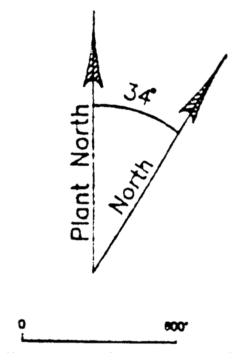
*TBCs include DOE Orders on this table.

AEA = Atomic Energy Act
CFR = Code of Federal Regulations
CWA = Clean Water Act
DOE = U.S. Department of Energy
FR = Federal Register
HWDU = Hazardous Waste Disposal Unit
MCL = maximum contaminant level
NA = Not applicable
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
NEPA = National Environmental Policy Act
NESHAP = National Emission Standards for Hazardous Air Pollutants
OSHA = Occupational Safety and Health Administration
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SDWA = Safe Drinking Water Act
TBC = to be considered
TCA = Tennessee Code Annotated
TDEC = Tennessee Department of Environment and Conservation
TSCA = Toxic Substances Control Act
USC = United States Code

Appendix E

AERIAL PHOTOGRAPHS SHOWING OVERVIEW OF SITE





— — —	Approximate Geologic Contact	GW-619 ■	Unconsolidated Zone Monitor Well	230	Annual Average Nitrate (as N) Concentration (mg/L)
OCk	Knox Group	GW-620 ●	Shallow Bedrock Zone Monitor Well (Unc - 85')	—10—	Line of Equal Concentration (dashed where approximate)
Cmn	Maynardville Limestone	GW-109 ▲	Intermediate Bedrock Zone Monitor Well (85' - 300')	——	Boundary of Site or Waste-Management Area
Cn	Nolichucky Shale	GW-208 ▼	Deep Bedrock Zone Monitor Well (300'+)		
Cm	Maryville Limestone	*	Indicates a Well sampled prior to 1990 (Data Qualitative)		
Crg	Rogersville Shale	**	Indicates a Well sampled in 1991 (Data Qualitative)		

#1087

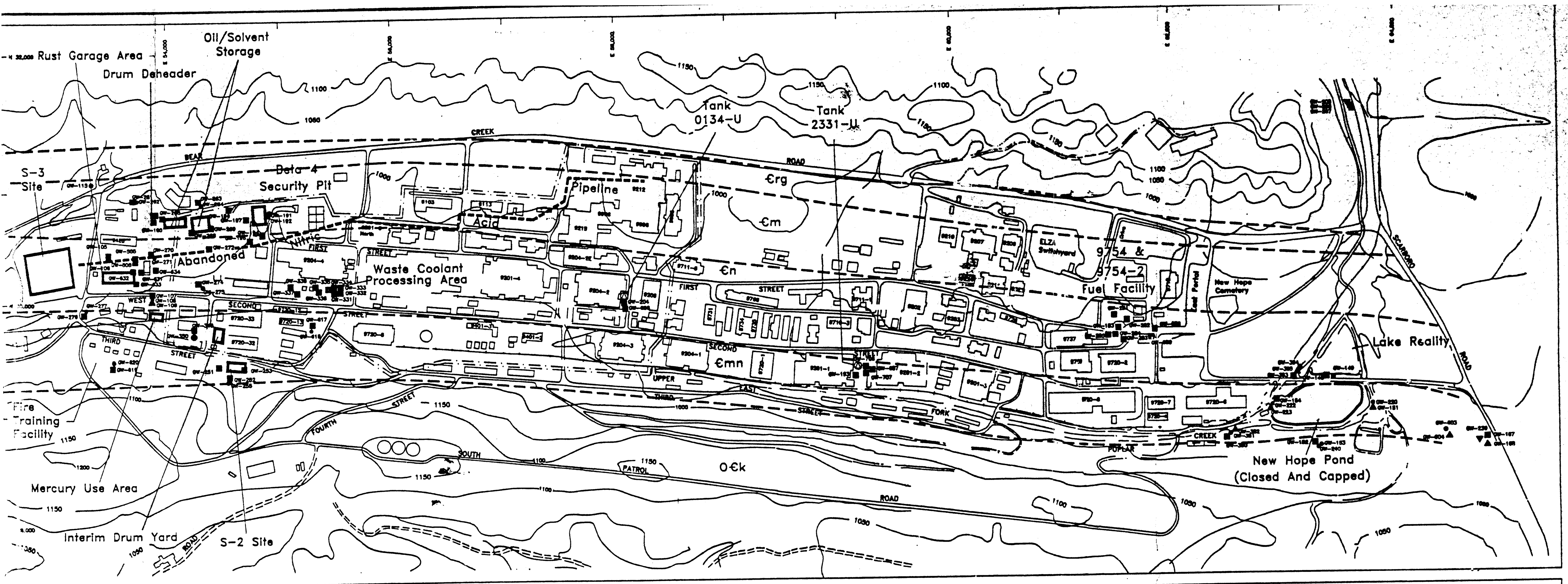
PLATE 1

Prepared for
MARTIN MARIETTA ENERGY SYSTEMS, INC.

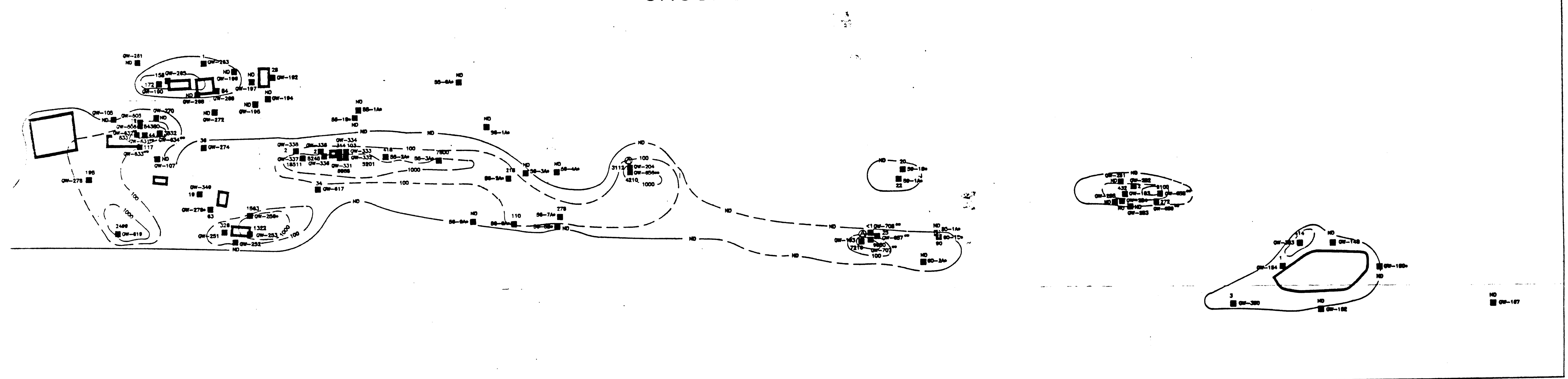
Title
Occurrence of Nitrate in Groundwater in the Upper East Fork Poplar Creek Hydrogeologic Regime

Compiled by HSW ENVIRONMENTAL CONSULTANTS, INC.

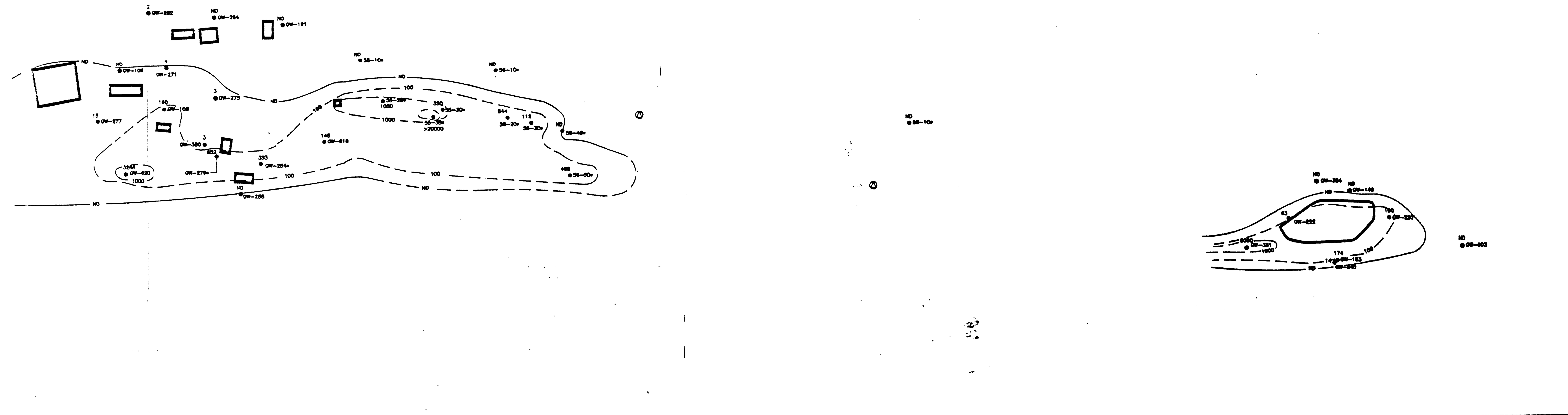
Date JUNE 1991



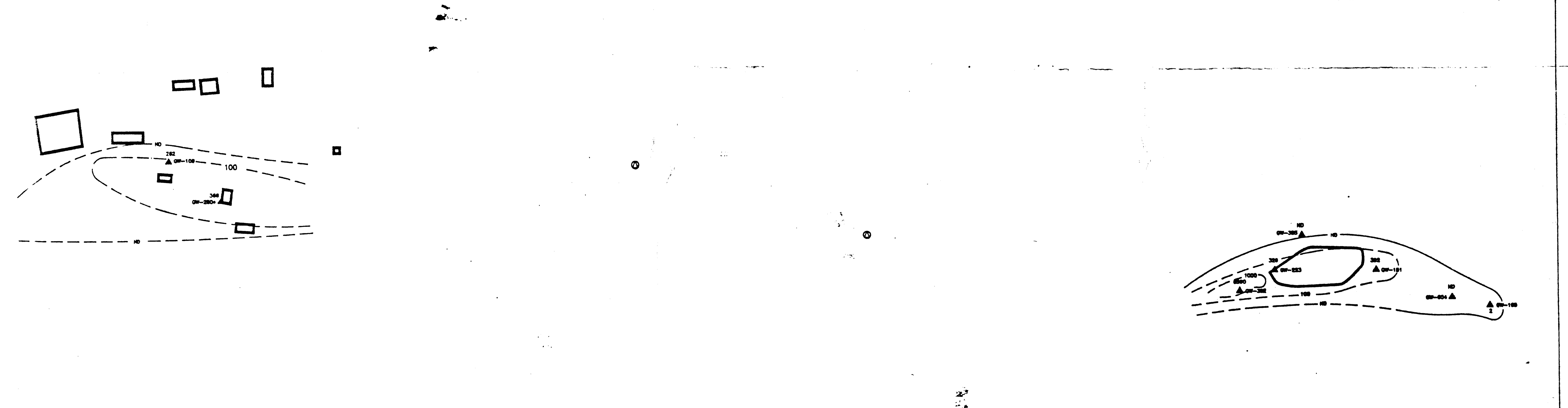
UNCONSOLIDATED ZONE

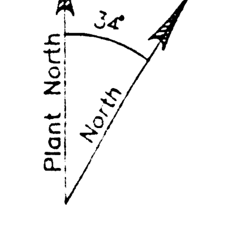


SHALLOW BEDROCK ZONE



INTERMEDIATE BEDROCK ZONE





— — —	Approximate Geologic Contact
OЄk	Knox Group
Єmn	Maynardville Limestone
Єn	Nolichucky Shale
Єm	Maryville Limestone
Єrg	Rogersville Shale

GW-619	■	Unconsolidated Zone Monitor Well
GW-620	●	Shallow Bedrock Zone Monitor Well (Une – 85')
GW-109	▲	Intermediate Bedrock Zone Monitor Well (85' – 300')
GW-208	▼	Deep Bedrock Zone Monitor Well (300'+)
	*	Indicates a Well sampled prior to 1990 (Data Qualitative)
	**	Indicates a Well sampled in 1991 (Data Qualitative)

230	Summed Average VOC Concentration (µg/L)
—100—	Line of Equal Concentration (dashed where approximate)
ND	Not Detected above Contract Required Quantitation Limit
▬	Boundary of Site of Waste-Management Area

#1087

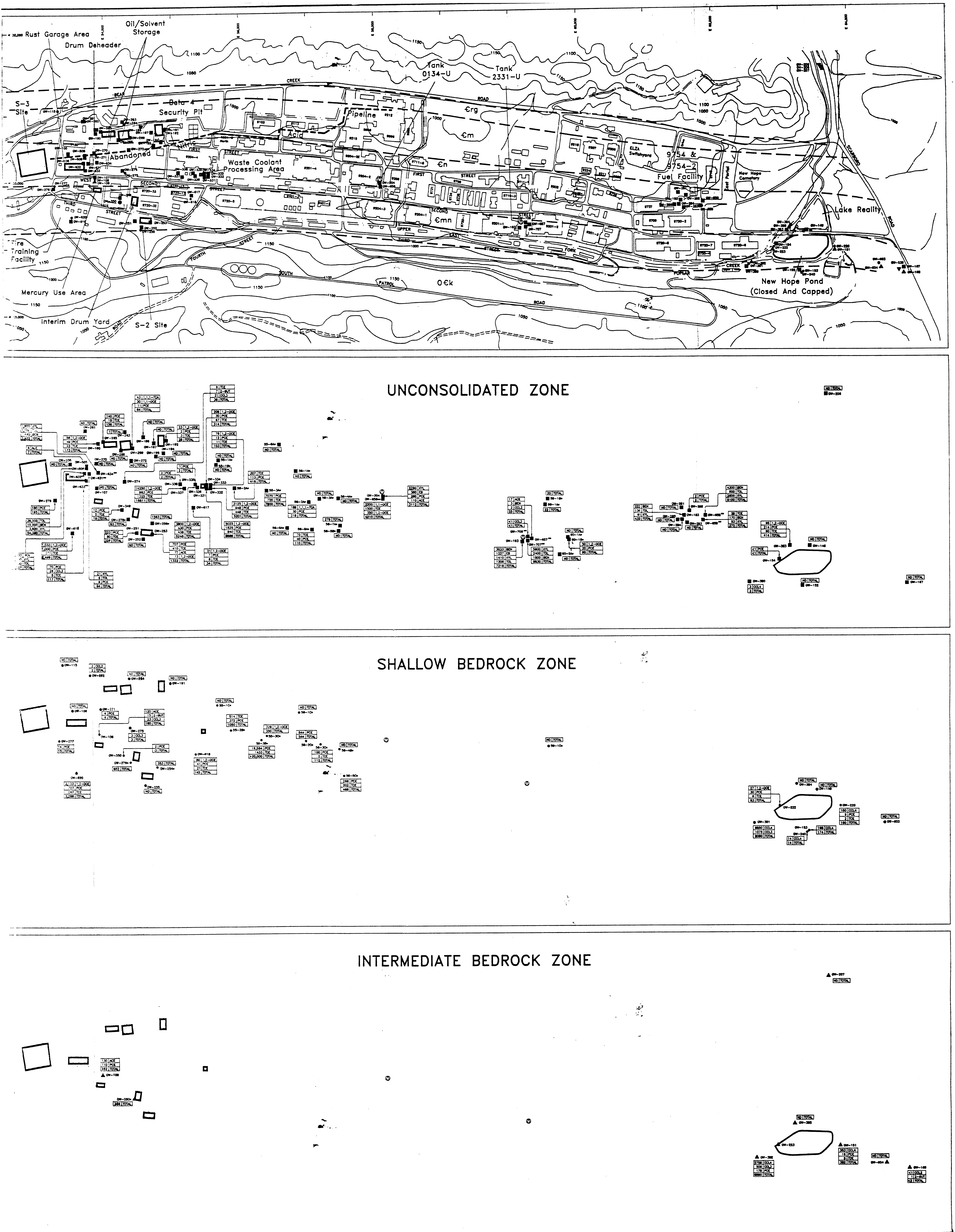
PLATE 2

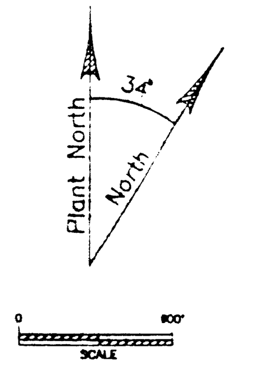
Prepared for: MARTIN MARIETTA ENERGY SYSTEMS, INC.

Title: Occurrence of Dissolved VOCs in Groundwater in the Upper East Fork Poplar Creek Hydrogeologic Regime

Compiled by: HSW ENVIRONMENTAL CONSULTANTS, INC.

Date: JUNE 1991





— — —	Approximate Geologic Contact
OCk	Knox Group
Cmn	Maynardville Limestone
Cn	Nolichucky Shale
Cm	Maryville Limestone
Crg	Rogersville Shale

GW-619	■	Unconsolidated Zone Monitor Well
GW-620	●	Shallow Bedrock Zone Monitor Well (Unc – 85')
GW-109	▲	Intermediate Bedrock Zone Monitor Well (85' – 300')
GW-208	▼	Deep Bedrock Zone Monitor Well (300'+)
*		Indicates a Well sampled prior to 1990 (Data Qualitative)
* *		Indicates a Well sampled in 1991 (Data Qualitative)

430	Average VOC Concentration (μg/L)
ND	Not Detected Above Contract Required Quantitation Limit
———	Boundary of Site or Waste – Management Area

1,1,1 – TCA	1,1,1 – Trichloroethane
1,1 – DCE	1,1 – Dichloroethene
1,2 – DCE	1,2 – Dichloroethene
2 – BUT	2 – Butanone
ACE	Acetone
BEN	Benzene
CCL2	Methylene Chloride
CCL3	Chloroform
CCL4	Carbon Tetrachloride
EB	Ethylbenzene
PCE	Tetrachloroethene
TCE	Trichloroethene
TOL	Toluene
XYL	Xylenes
TOTAL	Summed Average VOCs

PLATE 3

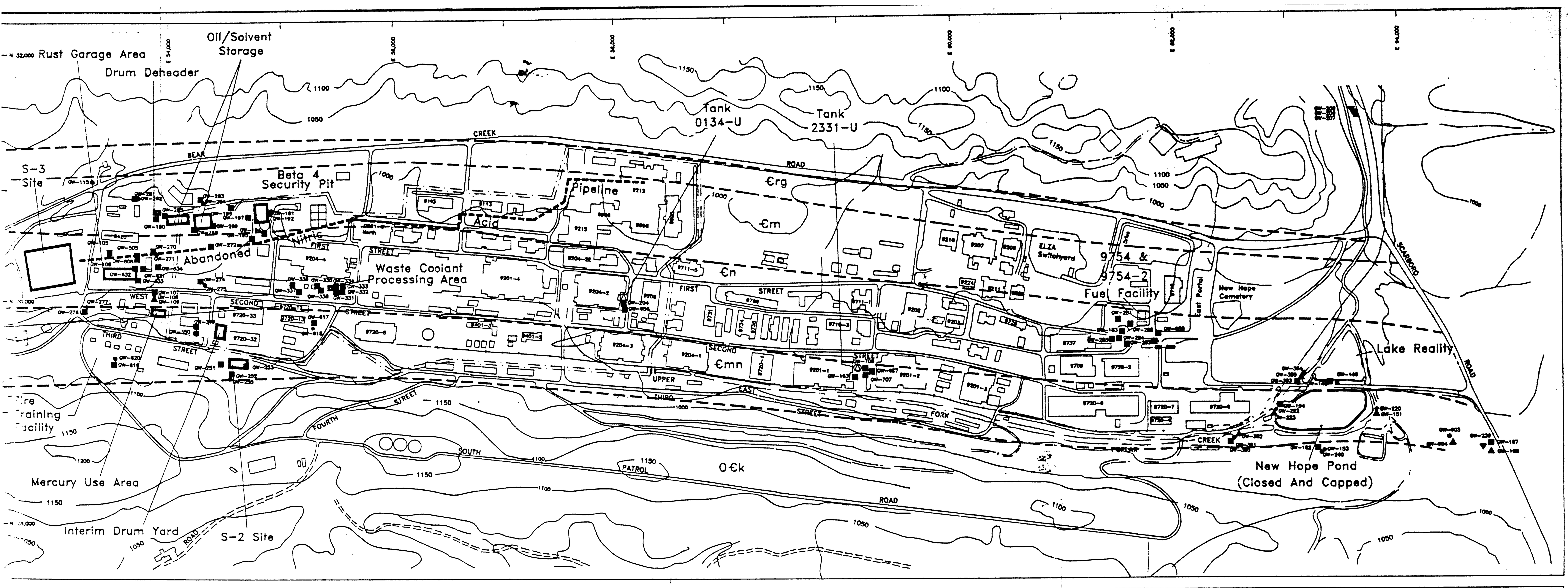
Prepared for: MARTIN MARIETTA ENERGY SYSTEMS, INC.

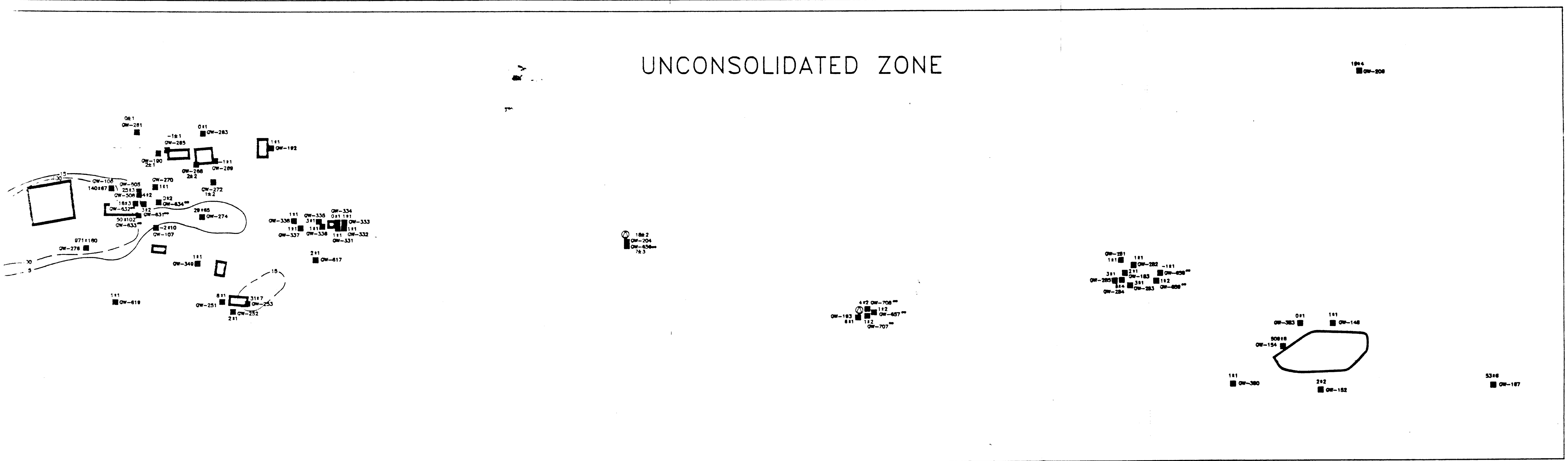
Title: Distribution and Summed Average Concentration of VOCs in Groundwater in the Upper East Fork Poplar Creek Hydrogeologic Regime

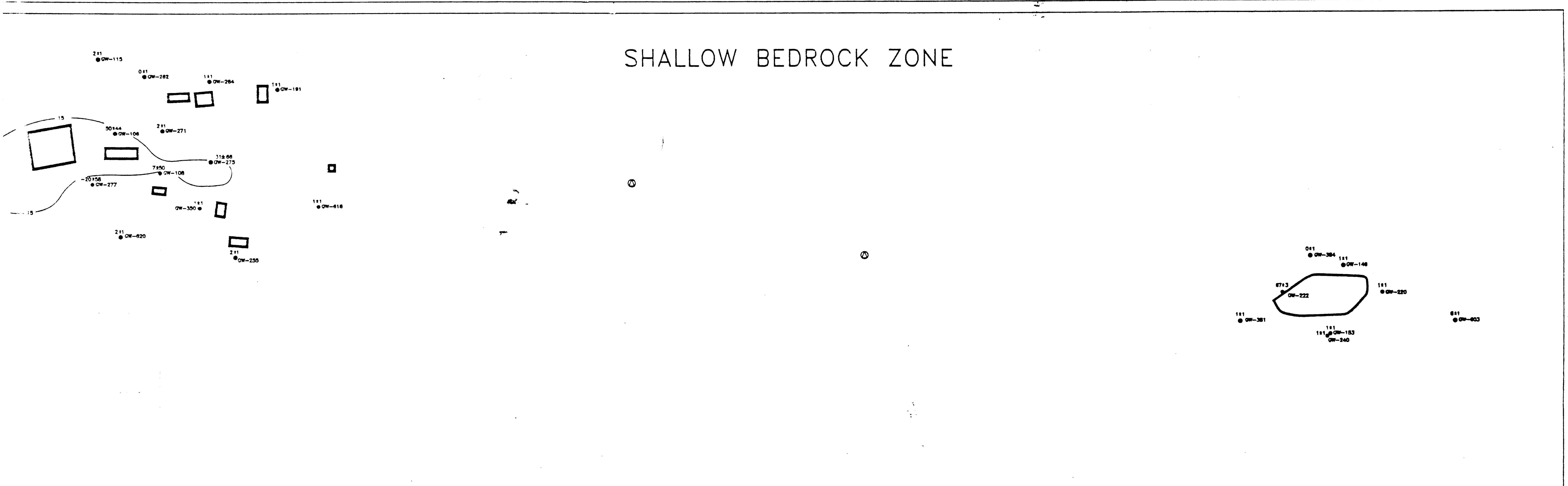
Compiled by: HSW ENVIRONMENTAL CONSULTANTS, INC.

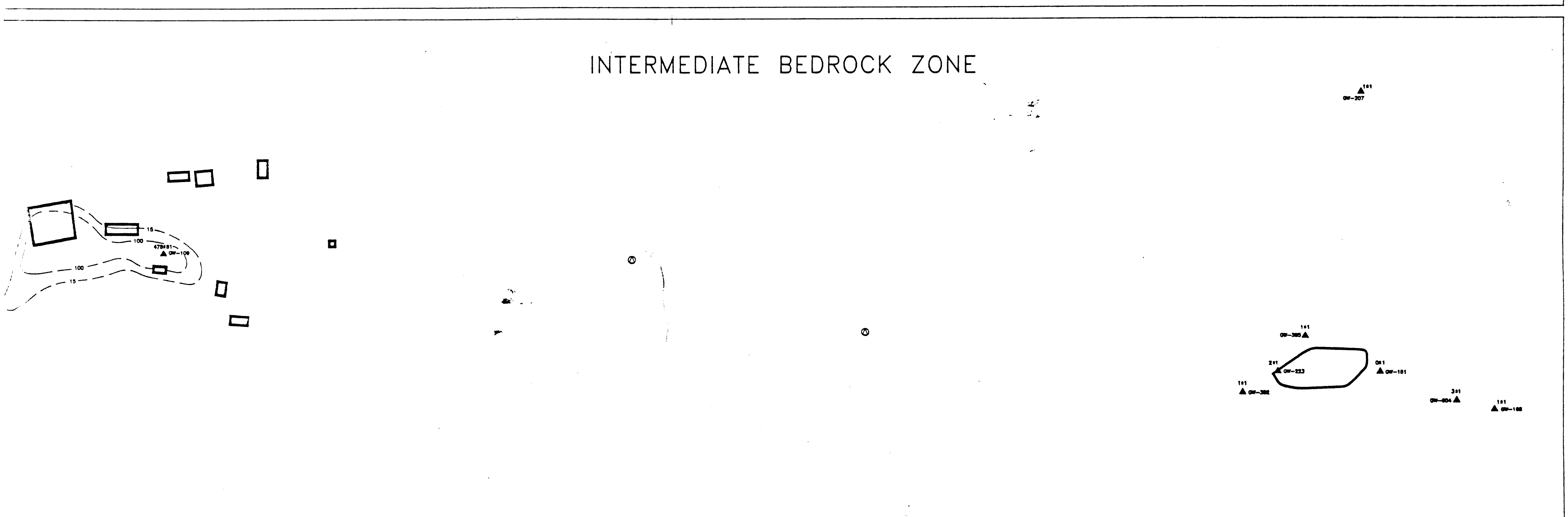
Date: JUNE 1991

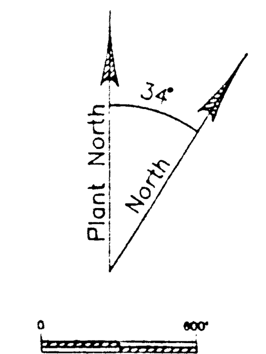
#1687











- Approximate Geologic Contact
- O€K — Knox Group
- €mn — Maynardville Limestone
- €n — Nolichucky Shale
- €m — Maryville Limestone
- €rg — Rogersville Shale

- GW-619 ■ Unconsolidated Zone Monitor Well
- GW-620 ● Shallow Bedrock Zone Monitor Well (Unc-85)
- GW-109 ▲ Intermediate Bedrock Zone Monitor Well (85-300)
- GW-208 ▼ Deep Bedrock Zone Monitor Well (300+)
- * * Indicates a Well sampled in 1991 (Data Qualitative)

- 12±6 — Annual Average Gross Apha Activity (pCi/L) and Mean Counting Error
- — 15 — Line of Equal Concentration (dashed where approximate)
- Boundary of Site or Waste – Management Area

1687

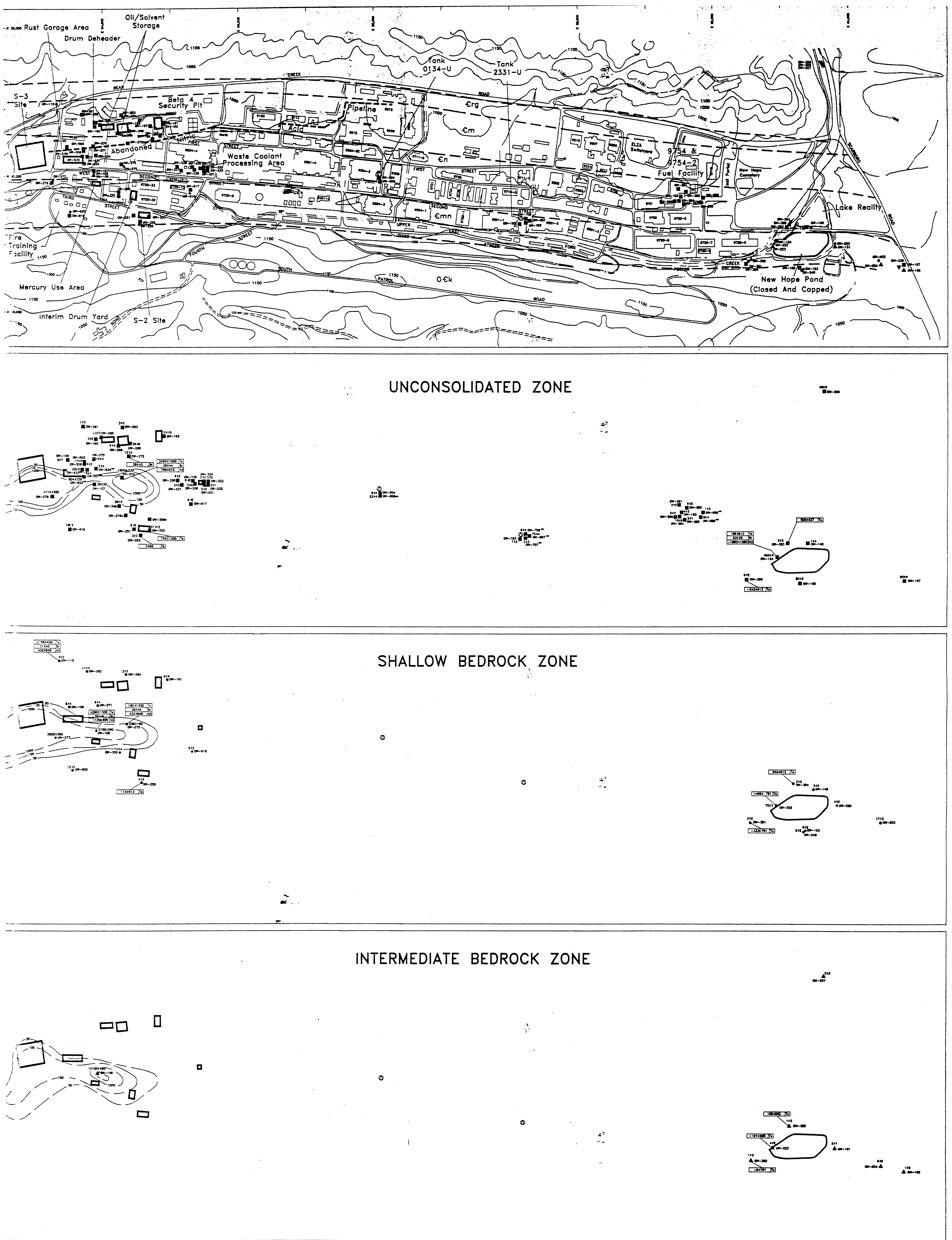
PLATE 4

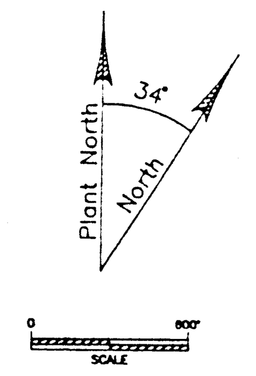
Prepared for: MARTIN MARIETTA ENERGY SYSTEMS, INC.

Title: Mean Gross Alpha Activity in Groundwater in the Upper East Fork Poplar Creek Hydrogeologic Regime

Compiled by: HSW ENVIRONMENTAL CONSULTANTS, INC.

Date: JUNE 1991





— — —	Approximate Geologic Contact	GW-52 ■	Unconsolidated Zone Monitor Well	12±2	Annual Average Gross Beta Activity (pCi/L) and Mean Counting Error
O€K	Knox Group	GW-621 ●	Shallow Bedrock Zone Monitor Well (Unc-85)	— 50 —	Line of Equal Activity (dashed where approximate)
€mn	Maynardville Limestone	GW-623 ▲	Intermediate Bedrock Zone Monitor Well (85–300)	▬	Boundary of Site or Waste – Management Area
€n	Nolichucky Shale	GW-115 ▼	Deep Bedrock Zone Monitor Well (300+)	Tc	Technetium – 99
€m	Maryville Limestone	*	Indicates a Well sampled prior to 1990 (Data Qualitative)	Sr	Strontium – 90
€rg	Rogersville Shale	* *	Indicates a Well sampled in 1991 (Data Qualitative)	H3	Tritium

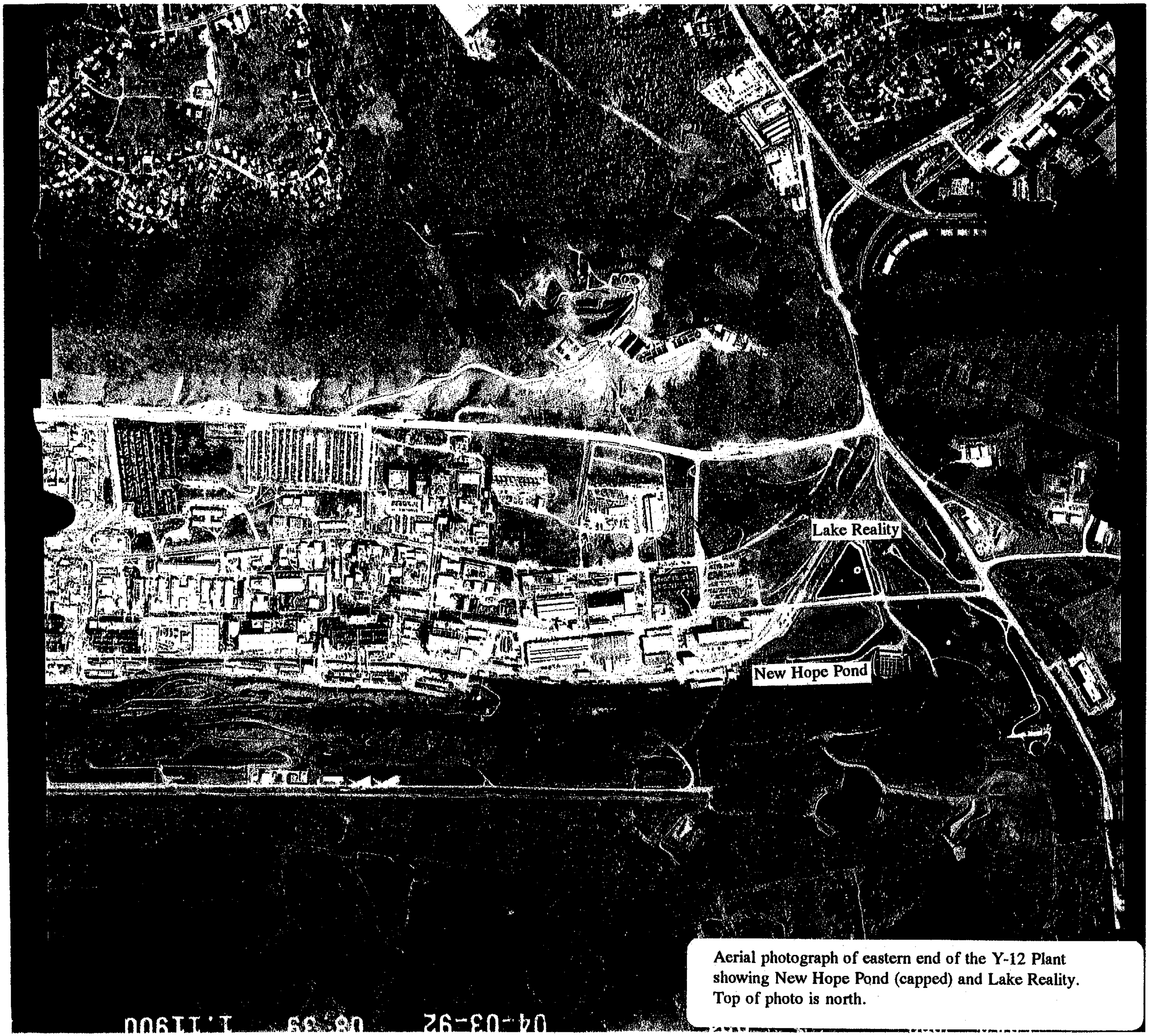
PLATE 5

Prepared for MARTIN MARIETTA ENERGY SYSTEMS, INC.

Title: **Mean Gross Beta Activity in Groundwater in the Upper East Fork Poplar Creek Hydrogeologic Regime**

Compiled by: HSW ENVIRONMENTAL CONSULTANTS, INC. | Date: JUNE 1991

#1087



Aerial photograph of eastern end of the Y-12 Plant showing New Hope Pond (capped) and Lake Reality. Top of photo is north.

Aerial photograph showing the Y-12 Plant, city of Oak Ridge (north), and Clinch River (southeast). Top of